Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV

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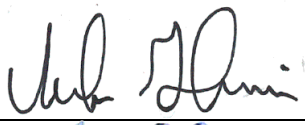
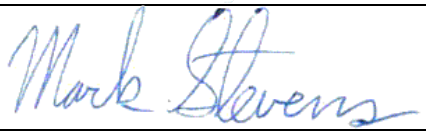
Recommended: M. Kelvin, P. Eng		Professional of Record 2026-03-12  Permit to Practice 1002449
Reviewed: M. Stevens, P. Eng		
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Reprint Provisions:

Customers and customer representatives please direct any questions or concerns to your local BC Hydro representative.

BC Hydro employees and contractors please direct any questions or concerns to Distribution Standards.

Acknowledgments:

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Table of Contents

1 Interpretation

This document contains the requirements for the design, construction, installation, access, and connection of customer-owned primary services supplied by the BC Hydro distribution system at 4 kV to 35 kV. Primary service connections are subject to BC Hydro's terms and conditions, which form part of the distribution tariff, according to Distribution Instruction A10-2 *Service Agreements*.

Note 1: See the BC Hydro document *Technical Interconnection Requirements for Transmission Voltage Customers for Service at 60,000 to 287,000 Volts* for electrical energy supply at 60 kV and above.

This primary service requirements document is intended neither as a design specification nor as an instruction manual for customer-owned primary services. This document shall not be used by the customer, nor their contractors or consultants, for such purposes. Persons seeking to use the information included in this document do so at no risk to BC Hydro and they shall rely solely upon themselves to ensure their use of all or part of this document is appropriate in the particular circumstances.

BC Hydro customers, their servants, and agents shall recognise they are solely responsible for their own design, construction, installation, and operation at all times. Neither BC Hydro nor any of its employees or agents shall either be or become the agent of the customer in any manner howsoever arising.

BC Hydro's review of the specifications and detailed plans shall be construed as neither conforming to or endorsing the design of, nor as warranting the safety, durability, or reliability of, the customer-owned primary service. Due to such reviews or lack thereof, BC Hydro shall neither be responsible for the strength, adequacy of design, nor capacity of equipment built pursuant to such specifications, nor shall BC Hydro or any of its employees or agents be responsible for any injury to the public or workers resulting from the failure of customer-owned primary services.

An assertion by BC Hydro or any of its employees or agents that the customer-owned primary service equipment design meets certain limited requirements of BC Hydro does not mean, expressly or by implication, that all or any of the requirements of the law or other good engineering practices have been met by the customer-owned primary service, and such judgement shall not be construed by the customer or others as an endorsement of the design, nor as a warranty, by BC Hydro or any of its employees or agents. If the customer opts to install BC Hydro standard products certified for utility use, the customer's engineers and contractors assume full responsibility and liability for the application, installation, approval, and use of such products and structures.

It is not the duty or function of BC Hydro to interpret or enforce the Canadian Electrical Code as applicable to the customer-owned electrical installation.

Note 2: Revision 5 (2026) of this primary service requirements document supersedes revision 4 and all previous revisions. A reference to any document external to the primary service requirements document always implies the most current edition/revision of said document.

2 Definitions

Term	Definition
Acceptable	Confirms that the customer-owned primary service design and specifications comply with the requirements of the BC Hydro primary service requirements document.
Approved certification marks for electrical products	See TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products*.
Authenticate	The act of a professional registrant manually authenticating or digitally authenticating a document in compliance with EGBC and displaying a valid permit to practice issued by EGBC.
BC Hydro representative	BC Hydro agent responsible for processing the customer application for primary service connection.
BCEC	The British Columbia Electrical Code is CSA C22.1 *Canadian Electrical Code Part I*, adopted and amended and enforced by TSBC.
Conduit or duct	Raceway of circular cross-section through which power cables or conductors are drawn per BCEC and BC Hydro standards.
Current permit	Written permission from the inspection department to a supply authority stating that electric energy may be supplied to a particular installation, See BCEC Section 0 *Definitions*
Customer	Any individual, person, partnership, company, or other entity receiving services from BC Hydro.
Distribution operating order	Formerly the local operating order, a special operating or maintenance procedure issued by BC Hydro to attend to, operate, and maintain certain equipment or apparatus connected to the BC Hydro distribution system.
Distribution standards	Standards for construction of a BC Hydro electrical distribution plant within the BC Hydro service area.
EGBC	Engineers and Geoscientists BC, the regulatory authority for professional engineers and geoscientists in B.C.
Electric service agreement	Formal legally-binding contract between BC Hydro and the customer that sets forth the terms of electrical energy supply.
Electrical operating permit	Permit to operate, maintain, and carry out minor alterations to the customer primary service per the B.C. *Safety Standards Act* and TSBC Directive B-E3 0708017 *Electrical Operating Permit Requirements*
Instrument transformer compartment	Switchgear cell or section of the primary service assembly containing revenue metering transformers, consisting of an enclosed metal box or cabinet constructed to be effectively locked or sealed.
Licensed electrical contractor	Person holding a licence as a contractor for the class of electrical equipment or electrical installation defined by TSBC.
Meter cabinet	Lockable wall-mounted metal box containing a Measurement Canada-certified BC Hydro revenue meter connected to the revenue metering instrument transformer compartment.
Point of connection	Physical location in the primary service equipment where BC Hydro, as supply authority, terminates service cables or conductors to deliver electrical energy.

Term	Definition
Primary service	The customer's service equipment connected to BC Hydro, as the supply authority, at primary distribution of 4 kV to 35 kV.
Primary service connection	Part of BC Hydro's medium-voltage distribution facilities extending from the first attachment point on BC Hydro's distribution system to the utility point of connection.
Primary service declaration	BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* available at all design offices.
Primary service dual supply	Two-feeder supply required by large loads (exceeding 6.5 MVA in a 7.2/12.5 kV area or exceeding 13.0 MVA in a 14.4/25 kV area) or by customers needing extra service reliability.
Primary service kiosk	Customer-owned outdoor structure containing an incoming service cable compartment, service switch, or breaker, and the outgoing cable compartment for connection of customer-owned cables. The kiosk may include a revenue metering cubicle, a service transformer, and secondary switchgear as a complete unitized substation.
Primary service requirements document	BC Hydro document containing the requirements for design, construction, installation, access, and connection of customer-owned equipment for primary services supplied by the BC Hydro distribution system at 4 kV to 35 kV.
Primary service switchboard	Switchgear assembly or portion thereof consisting of one or more switchgear compartments or cells, containing a primary service cable termination compartment, a service switch or breaker and associated relaying, and, where applicable, a primary revenue metering cubicle.
Primary service vault	Room or space in a building to accommodate primary service equipment, constructed in accordance with the National Building Code of Canada, BCEC, and applicable local bylaws.
Primary voltage	Voltage greater than 750 V and up to 34.5 kV, measured phase-to-phase.
Professional of record (POR)	A professional registrant in good standing with Engineers and Geoscientists BC (EGBC) who is professionally responsible for the engineering activities, work, or documents related to the regulated practice.
Protective barrier	Permanent or removable insulation board or fitting, mounted separately from the exposed electrical components, to prevent contact with energized components.
Pull box	Metal or concrete box to facilitate installation of service cables or conductors.
Regional distribution engineer	Professional engineer in BC Hydro's employ responsible for a designated portion or a geographic area of the BC Hydro distribution system.
Registered class A electrician	Licensed electrical contractor with unlimited voltage restriction and trade qualifications per the B.C. *Safety Standards Act*.
Regulatory authority	Ministry or local government that provides for inspection services and has the authority to require inspection of electrical work in B.C.
Rigid metal conduit	Rigid conduit of metal pipe made to the same dimensions as standard pipe and suitable for threading with standard pipe threads.
Secondary voltage	Voltage up to and including 750 V, measured phase-to-phase.
Shunt trip	Assembly consisting of a pushbutton enclosure that can be locked, containing a pushbutton with ¼-turn release, hard-wired to the trip coil of a circuit breaker, interrupter, or loadbreak switch.

Term	Definition
Single radial supply	Comprising the incoming cable termination and a gang-operated disconnect or loadbreak switch.
Statutory right-of-way	Registered right-of-way on private property or inside a customer-owned building granted by the owner to BC Hydro for its function as an electric utility.
Supply authority	British Columbia Hydro and Power Authority
Supply service cable compartment	Switchgear cell or section of the primary service assembly containing primary service cables or conductors, and consisting of an enclosed metal box or cabinet constructed to be bolted down with three penta bolts, and locked by a BC Hydro padlock.
Supply service cables or conductors	Any one set of conductors run by BC Hydro from its mains to a consumer's primary service point of utility connection.
TSBC (Technical Safety BC)	Organization responsible for administering and enforcing the BCEC and safety of regulated technical equipment and systems in British Columbia to protect public safety.
Visible disconnection point	Physical location in primary service equipment where supply may be interrupted and that allows direct and safe visual confirmation of separated contact by BC Hydro personnel without the use of climbing structures.

3 System Requirements

3.1 Design, Compliance, and Jurisdiction

The safety and reliability of each primary service is important to BC Hydro for the life expectancy of the service connection. New primary service equipment shall be rated and certified for operation at 14.4/25 kV. Customer connections in 14.4/25 kV service areas need not be dual-voltage rated. Initial operation at 7.2/12.5 kV may be required in some areas. BC Hydro distribution supply is 19.9/34.5 kV in some rural areas.

Note 3: BC Hydro shall not supply any customer primary service designed and constructed to operate as a three-phase two-wire service, regardless of geographic location.

Customer-owned primary service equipment and installations shall be technically compatible with the BC Hydro distribution system to ensure public safety and facilitate safe and reliable delivery of electrical energy. Designs for customer-owned primary services shall be authenticated by the customer's POR in compliance with EGBC requirements. Deviations from BC Hydro distribution standards that are directly applicable to the customer's installation require acceptance by BC Hydro.

Customer-owned primary services are TSBC jurisdiction. All equipment shall have approved certification marks for electrical products. See TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products*.

Customers exempt from the BCEC shall provide BC Hydro with a confirmation letter from the authority having jurisdiction that a subject primary service is suitable for connection to the BC Hydro distribution system. This does not exempt such customers from fully complying with BC Hydro requirements as the supply authority.

Customer primary service installations that do not meet BC Hydro requirements may be connected and maintained under a special provision through a distribution operating order. This may carry extra charges to the customer for service calls, regular inspections, and required maintenance by BC Hydro personnel.

Note 4: Customer-owned primary service equipment, operation, and installation are the jurisdiction of TSBC and subject to the BCEC. BC Hydro will not issue an authorization for connection for customer-owned primary service until the customer provides the current permit.

3.2 Utility Access

Access to the primary service location on private property, supply service cables or conductors, and revenue metering, including operation and safe isolation of the main service switch, shall be reviewed with a BC Hydro designer for compliance with BC Hydro work procedures prior to acceptance. See 8.3.1 *Vault Location and Access* for location and access requirements for buildings with indoor primary service vaults.

Buildings supplied by an open loop configuration with the BC Hydro switchgear room located inside require BC Hydro parkade access with a keyed switch access panel connected to the parkade overhead door electric operator. See BC Hydro distribution standard ES55 B2-05 *Customer Guide: BC Hydro-Owned Switchgear Placement and Requirements*.

BC Hydro crews require unobstructed roadway access to primary overhead services for line trucks to the customer's first pole and revenue metering pole.

3.3 Supply Configuration

Primary service supply configuration depends on geographic location, service rating (kVA), and service connection type (overhead or underground). The six supply configurations are:

a. Single radial supply: The most common configuration for overhead and underground supply throughout the province (see drawings PG A1-01 *One Line Diagram Single Radial Supply Typical for*

U/G Supply Service and PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* in Appendix 1 List of Primary Service Requirements Standards). The customer service connection for overhead supply includes a pole-mounted loadbreak switch and fused cutouts. Customer service for underground supply may comprise an incoming cable cubicle and loadbreak switch with fuses, or an isolation switch in conjunction with a circuit breaker or interrupter. Some indoor installations use draw-out breakers.

b. Primary loop supply: An obsolete configuration used in certain areas (e.g. Surrey, Victoria) as defined in the *Electric Tariff*.

c. Primary open loop supply: Customers in areas designated by BC Hydro may receive a single radial supply from BC Hydro-owned switchgear located on the customer's premises in an inside room or outside space. Switchgear space requirements are outlined in the underground civil standards. See BC Hydro distribution standard ES55 B2-05 *Customer Guide: BC Hydro-Owned Switchgear Placement and Requirements*.

d. Dual radial supply: Legacy configuration comprising one running and one standby feeder. Effective April 1, 2009, a customer requesting service in a previously designated dual radial area is offered single radial supply or may be requested to provide space on their property for BC Hydro switchgear to facilitate primary open loop supply. See 9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference) for more information.

e. Dual supply: May apply to large connected loads as defined by BC Hydro (typically exceeding 6.5 MVA in a 7.2/12.5 kV area or exceeding 13 MVA in a 14.4/25 kV area). Customers may be served by two feeders (see drawing PG A2-01 *One Line Diagram Dual Supply* in Appendix 1 List of Primary Service Requirements Standards). Customers connecting such large loads to BC Hydro's system shall consult with BC Hydro to establish connection requirements prior to commencing construction.

f. Dedicated backup supply: May be available upon customer special request at BC Hydro's discretion.

BC Hydro continues to upgrade the distribution system and to use remotely-operated automated switchgear for improved service reliability. Dual radial and double dual radial service connections are no longer available for new construction. All BC Hydro primary customers will receive some form of radial supply configuration with system redundancy. Redundancy of the supply system could be provided by BC Hydro-owned switchgear in some geographic locations, which may be located on the customer's private property or inside a customer-owned building, and may require a BC Hydro right-of-way.

Note 5: The customer shall contact the area's BC Hydro representative regarding supply configuration for a proposed primary service supply. Contact a BC Hydro representative for further information on special requirements and available feeder capacity.

3.4 Point of Connection

The point of connection for overhead and underground primary service supply shall follow the applicable rules of BCEC section 36 *High-voltage installations* and TSBC Information Bulletin IB-EL 2016-02 *High voltage installations*.

The BC Hydro point of connection for overhead service shall be the first customer-owned pole located on private property, and for underground service the supply service cable compartment as shown in BC Hydro ES54 S3 *Primary Services* distribution standards. The BC Hydro point of connection for underground indoor service shall be the utility service cable compartment above a cable pull pit located on a ground floor or parking level P1. A P2 location is acceptable if ground floor and P1 are unavailable due to local authority having jurisdiction bylaws. See 3.2 Utility Access for additional requirements. The cable pull pit in high flood plain areas may be replaced by a pull box located outside the building near the primary service. See BC Hydro distribution standard ES54 S0-02 *Services General Notes*.

If a customer installs non-compliant primary service equipment or has extenuating circumstances which result in the need to restrict BC Hydro access to the primary service location, BC Hydro requires a demarcation structure as the point of connection. This demarcation structure shall be pad-mounted and accepted by BC Hydro as the supply authority, and by the authority having jurisdiction. The demarcation structure shall be supplied and installed by the customer and located inside the customer property line. The demarcation structure shall ensure separation between the customer and BC Hydro equipment in the form of a primary service kiosk compliant with this document, or a pad-mounted enclosure design acceptable to BC Hydro. A BC Hydro standard 832 box is not acceptable. See Appendix 2 Reference Documents for further information on the requirements of a demarcation structure.

Note 6: BC Hydro shall not connect customer service to a building or structure that violates minimum clearance requirements to BC Hydro overhead lines as stipulated by CSA C22.3 No. 1 *Overhead systems* and BC Hydro ES43 overhead electrical standards.

3.5 Revenue Metering

BC Hydro accepts primary or secondary revenue metering for all primary services but prefers secondary metering as the lower cost option. See the BC Hydro documents *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)* and *Requirements for Secondary Voltage Revenue Metering (750 V and less).*

The power supply for loads inside the service, such as heaters, relays, lights, and convenience plugs, shall be connected after the revenue metering point. The customer is required to show this type of dedicated supply circuit on the one-line diagram.

Applicable BC Hydro distribution standard documents, including revenue metering documents, are available on the BC Hydro website. The final metering configuration shall be determined in consultation with a BC Hydro representative.

BC Hydro-specific requirements for primary overhead metering include a separate dedicated customer-owned new class 2 wood pole (typically the second pole on a private line) for the installation of a revenue metering assembly and associated surge arresters (see BC Hydro standard ES43 J7-01 *Primary Revenue Metering*). Customer-owned equipment shall not be installed on a revenue metering pole, except for surge arresters per drawing PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* (see Appendix 1 List of Primary Service Requirements Standards).

Note 7: BC Hydro primary revenue metering for overhead and underground service connections shall be located after the customer service main overcurrent protection devices.

BC Hydro requirements for primary underground services includes a separate metering cubicle with access restricted to BC Hydro personnel only. Customer-owned equipment shall not be installed inside a revenue metering cubicle. Potential transformers and current transformers in the metering cubicle shall meet the requirements specified in the BC Hydro document *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV).*

The point-of-metering (POM) shall be on the service transformer secondary side where practicable. The POM may be on the primary side under special circumstances (subject to BC Hydro acceptance), including:

a. Multiple service transformers;

b. A single service transformer with multiple secondary windings;

c. A single service transformer with non-standard secondary voltage; and

d. A customer-owned primary voltage overhead power line.

Revenue metering with the POM on the secondary side shall be in accordance with the BC Hydro document *Requirements for Secondary Voltage Revenue Metering (750 V and less)*.

Warning: BC Hydro issues refurbished primary revenue metering transformers to contractors for installation inside customer-owned primary service switchgear. Refurbished metering transformers may have a reduced dielectric strength rating compared to the customer-owned switchgear. When the customer carries out the necessary type testing per CSA standards, BC Hydro potential transformers shall be disconnected by removing primary fuses, and each current transformer shall be jumpered across by a solid copper bus between transformer terminals.

3.6 Power Quality and Customer Emission Limits

Customer primary service operation shall not generate disturbance on the BC Hydro system. A customer causing excessive disturbance to a BC Hydro feeder could be faced with service disconnection if they fail to install or enact suitable mitigation as stated in their Electrical Service Agreement. See the following BC Hydro emission limit design standards for more information:

a. ES55 Q4-04 *Rapid Voltage Changes*;

b. ES55 Q4-05 *Voltage Flicker*;

c. ES55 Q4-07 *Voltage Unbalance*; and

d. ES55 Q4-09 *Current Harmonics*.

Primary customers operating below a 0.9 power factor may be subject to additional penalties. Customers should not operate with a leading power factor.

Note 8: BC Hydro strongly recommends installing loss-of-phase protection for sensitive customer loads that may be subject to damage from single-phasing conditions. Supply for computers and similar sensitive equipment may require special quality service to buffer against switching transients which may occur on the BC Hydro distribution system.

3.7 Customer Service Entrance Equipment

BC Hydro accepts the following customer-owned utility service mains:

a. Ganged loadbreak switch and fuses mounted on the first customer-owned class 2 pole;

b. Ganged loadbreak switch mounted on the first customer-owned class 2 pole and recloser on the second customer class 2 pole with the reclose function disabled (see note 21);

c. Ganged loadbreak switch and fuses inside the customer’s primary service switchgear;

d. Fixed breaker with isolation switch inside the customer’s primary service switchgear;

e. Draw-out breakers with lock-out and grounding provisions;

f. Vacuum or SF_6 insulated switches, interrupters, and breakers, indoor and outdoor; and

g. Live-front or dead-front equipment.

The customer shall install surge arresters close to the load side of the pole-top loadbreak switch for overhead line primary services. Surge arresters for services with primary revenue metering shall be installed on the metering pole for the most effective protection of the revenue metering cluster (see BC Hydro standard ES43 J7-01 *Primary Revenue Metering*). Surge arresters are not required for services with secondary revenue metering by BC Hydro at the pole-top loadbreak switch provided they are installed at transformer primaries just ahead of BC Hydro meters.

The customer shall install surge arresters on the load side of the service switch for underground primary services that have primary revenue metering. Secondary surge arresters for services with secondary revenue metering are not required by BC Hydro if surge arresters are present on the load side of the primary switch

(see drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* in Appendix 1 List of Primary Service Requirements Standards).

Note 9: See 10 Primary Service Protection Requirements for overcurrent protection and coordination requirements.

3.8 Primary Service Voltage Conversion Requirements and Procedure

BC Hydro is continuously upgrading and expanding the power distribution grid for improved service reliability and to meet the growing demand for electrical energy. BC Hydro feeders are being upgraded from 12.5 kV to 25 kV, which may require existing customers to upgrade their customer-owned primary service equipment.

Primary service voltage conversion is a major undertaking. BC Hydro will provide minimum six months advance notice of proposed conversions to affected primary customers to allow adequate time for design and construction of the customer service upgrade.

Customer-owned primary service equipment shall meet the requirements for higher primary supply voltage and increased fault level, overcurrent protection, potential rise of ground grid, and step-and-touch voltage requirements per BCEC section 36 *High-voltage installations*. The customer shall follow all steps and obtain the necessary electrical permits, inspections, and approvals described in 5 Submission Procedures.

3.9 Customer-Owned Standby Generation

Customer-owned standby generation is classified as either open-transition (“break-before-make”) or closed-transition (“make-before-break”).

3.9.1 Open-Transition Standby Generation

Customer-owned standby generators and transfer switches are the jurisdiction of TSBC or local authority having jurisdiction for acceptance of the installation subject to review and acceptance of a safety interlock scheme by BC Hydro.

Solid state switching devices operating in either open or closed transition are not acceptable.

A customer may operate an open-transition standby generator at primary or secondary voltage as an emergency power supply, independent and disconnected from BC Hydro service. The generator must never operate in parallel with BC Hydro service before or after BC Hydro supply is restored.

The following applies for a secondary voltage open-transition standby generator:

a. Manufactured manual or automatic transfer switches shall meet the requirements of CSA C22.2 No. 178.1 *Transfer switch equipment (Trinational standard with NMX-J-674-ANCE and UL 1008)*; and

b. Interlock schemes shall be reviewed and accepted by BC Hydro when mechanical key interlocks are used. BC Hydro accepts two configurations for locking out BC Hydro supply, either a lock installed on the primary service main or the secondary service main interlocked with a secondary standby generator. Figure A1-1 in Appendix 1 shows a typical interlock scheme for locking out the BC Hydro primary and customer secondary supply (locked closed position is indicated with key held captive).

The following applies for a high-voltage open-transition standby generator:

a. Manufactured manual or automatic transfer switch shall meet the requirements of CSA C22.2 No. 178.3 *Transfer switch equipment, over 1000 volts (Binational standard with UL 1008A)*; and

b. BC Hydro requires a distribution operating order for safety isolation and disconnection of the BC Hydro utility supply where mechanical key interlocks are used, such as in shopping malls or institutions. Interlock schemes, which include locking out the BC Hydro high-voltage supply, shall be reviewed and accepted by BC Hydro. Figure A1-2 in Appendix 1 shows a typical interlock scheme for

locking out the BC Hydro and customer primary supply (locked closed position is indicated with key held captive).

Manual transfer switches in high or low-voltage installations, field-fabricated or non-manufactured, shall conform to the following:

a. The switching means shall be mechanically held, and the operation shall be by direct manual control or by electrical remote manual control using control power from the supply to which the load is being transferred;

b. A manual transfer switch operated by electrical remote manual control shall include a means for safe manual mechanical operation;

c. Reliable mechanical interlocking (and, in the case of a switch operated by electrical remote manual control, electrical interlocking) to prevent interconnection of the normal and emergency electrical power supply systems shall be inherent in the design of a manual transfer switch; and

d. Switches shall include a readily visible mechanical indicator showing the switch position.

Mechanical key interlocked devices shall be operated by qualified personnel only.

Essential electrical systems are those for life safety (i.e. fire water pumps, egress systems) and patient care (i.e. hospitals) and are not permitted to use field-fabricated or non-manufactured manual transfer switches per CSA C22.1 section 24.

3.9.2 Closed-Transition Standby Generation

A customer may operate standby generation in parallel with BC Hydro supply for up to 20 seconds in a closed-transition transfer. Such parallel operation requires written acceptance from BC Hydro. See the BC Hydro distribution generator interconnections website for application forms, generator interconnection requirements, and the written approval process. Closed-transition transfer requirements can be found in the BC Hydro document *Interconnection Requirements for Closed-Transition Transfer of Standby Generations*.

3.9.3 Customer-Owned Non-Standby Generation

A customer may operate non standby/active/continuous generation in parallel with BC Hydro supply (such as grid-tied photovoltaic inverters) with written approval from BC Hydro. See the BC Hydro distribution generator interconnection website for application forms, generator interconnection requirements, and the written approval process.

3.10 Maintenance and Testing

The customer is responsible for regular maintenance and testing of their primary service equipment in accordance with manufacturers' recommendations and as required by TSBC or a local authority having jurisdiction to maintain their operating permit. Though BC Hydro personnel do not normally operate customer-owned equipment, operating authority over certain types of equipment (i.e. dead-front services and dual radial services) may be required. Such equipment shall clearly display the last maintenance tag date. BC Hydro personnel will not operate the equipment with an unacceptable or missing maintenance tag. This may result in prolonged outages or single phasing of the customer's supply. Protective relay settings and operation and circuit breaker operation shall be set and tested by the customer and accepted by BC Hydro before energization. BC Hydro reserves the right to inspect and test the equipment at any time, and to request necessary maintenance. This inspection does not relieve the customer of their responsibility for equipment maintenance.

WorkSafeBC and BC Hydro safety rules for existing dual radial supply customers require customers owning or managing dual radial vaults to perform maintenance on running and standby circuit switches every 42 months (3.5 years). BC Hydro provides two to three maintenance windows each year to help customers

maintain their equipment in a timely manner. The customer is required to conduct maintenance to avoid becoming non-compliant. When maintenance occurs, the customer's electrical contractor shall de-energize the vault in coordination with BC Hydro, disassemble the equipment, clean the components, test the equipment, and coordinate with BC Hydro to re-energize the vault. Maintenance is booked within BC Hydro's pre-determined time windows. All work is carried out by the customer at the customer's expense.

The customer primary service space/vault is designated for restricted access to qualified personnel per WorkSafeBC Occupational Health and Safety Regulation Part 19 *Electrical Safety*. The primary service vault shall not be used as a storage room, which can obstruct access to service equipment and hinder emergency egress from the vault. These requirements are explicitly stated in the B.C. Fire Code Regulation, BCEC, and WorkSafeBC regulation (see the 'No Storage Allowed' sign in Appendix 2 Reference Documents.)

3.11 Customer Application Process

The customer primary service application and connection procedure is described in the *Primary Service Connections* flowchart in Appendix 2 Reference Documents . Customers are advised to follow the flowchart to expedite application processing.

3.12 Fire Protection

Exposed BC Hydro primary service cables passing through a fire-rated building wall or partition require the customer to install 4" diameter Hilti CFS-SL GA L firestop speed sleeves, one sleeve for each cable. Other firestops such as metal duct sleeves filled with spray foam, composite duct seals, or hard cast putty, are not acceptable.

The fire marshall may require a remotely operated shunt trip be installed on the primary service main for new or existing services. A shunt trip auxiliary assembly and remote pushbutton are acceptable to BC Hydro for this function subject to the following requirements:

a. Retrofit shunt trip installation shall be certified per applicable CSA switchgear standards;

b. Shunt trip assembly shall not hinder visual confirmation of the switch blades and contacts;

c. Shunt trip assembly and operation shall not obstruct padlocking means in open and ground position;

d. Shunt trip mechanism shall not interfere with manual opening of the service main;

e. If the shunt trip assembly fails, such failure shall not interfere with manual opening or closing of the service main;

f. Shunt trip pushbutton shall have a dry-type contact hard-wired into the contactor/breaker trip coil and hard-wired interlock to prevent operation of the contactor/breaker close coil until the trip pushbutton is reset;

g. The remote shunt trip shall be supplied, installed, and connected by the customer; and

h. The remote shunt trip for fire protection shall be located in a readily accessible location as directed by the fire marshall.

4 References

Requirements of regulatory authorities having jurisdiction contained in this document for primary services at the site are in addition to the latest revisions of these applicable documents:

1. BC Building Code;
2. BCEC;
3. B.C. *Electrical Safety Regulation;*
4. B.C. *Engineers and Geoscientists Act*;
5. BC Hydro *35 kV and Below Interconnection Requirements for Power Generators*
6. BC Hydro distribution standards;
7. BC Hydro Distribution Instruction A10-2 *Service Agreements;*
8. BC Hydro *Electric Tariff*;
9. BC Hydro Equipment Advisory 2016-016 *Transfer Switches for Secondary Customer Services Emergency Standby Generators*;
10. BC Hydro Equipment Advisory 2017-002 *Release of ES55 Series Q3 and Q4: Customer Power Quality Emission Limits for Connection to Low- and Medium-Voltage Networks*;
11. BC Hydro *Interconnection Requirements for Closed-Transition Transfer of Standby Generations;*
12. BC Hydro *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)*;
13. BC Hydro *Requirements for Secondary Voltage Revenue Metering (750 V and less);*
14. BC Hydro *Statement Regarding Primary Voltage Service Entrance Equipment;*
15. BC Hydro *Technical Interconnection Requirements for Transmission Voltage Customers for Service at 60,000 to 287,000 Volts;*
16. B.C. Ministry of Energy, Mines, and Petroleum Resources; PO Box 9320, Victoria BC, Tel. 250-952-0793;
17. B.C. *Safety Standards Act;*
18. CSA C22.2 No. 0 *General requirements – Canadian Electrical Code, Part II*
19. CSA C22.2 No. 31 *Switchgear assemblies*;
20. CSA C22.2 No. 41 *Grounding and bonding equipment*;
21. CSA C22.2 No. 178.1 *Transfer switch equipment (Trinational standard with NMX-J-674-ANCE and UL 1008);*
22. CSA C22.2 No. 178.3 *Transfer switch equipment, over 1000 volts (Binational standard with UL 1008A);*
23. CSA C22.3 No. 1 *Overhead systems*;
24. CSA C22.3 No. 7 *Underground systems*;
25. CAN-C235-83 *Preferred Voltage Levels for AC Systems, 0 to 50 000 V;*
26. CSA C83-17 *Communication and power line hardware;*
27. IEEE C37.90 *Standard for Surge Withstand Capabilities (SEC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus;*

28. IEEE 48 *Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV;*
29. IEEE 80-2013 *Guide for Safety in AC Substation Grounding;*
30. IEEE 386 *Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV;*
31. TSBC Directive D-E3 090313 1 *High voltage installations*;
32. TSBC Directive D-E3 070801 7 *Electrical operating permit requirements*;
33. TSBC Directive D-EL 2017-01 *Exemptions to public utilities*;
34. TSBC Information Bulletin IB-EL 2016-02 *High voltage installations;*
35. TSBC Information Bulletin IB-EL 2017-04 *Electrical safety regulation application to public utilities*;
36. TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products;*
37. TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines*; and
38. WorkSafeBC Occupational Health and Safety Regulation Part 19 *Electrical Safety*.

5 Submission Procedures

5.1 Preliminary Design

Customers should visit the BC Hydro website for further resources in addition to the exchange of information described in this section.

5.1.1 Customer Submissions

Customers should refer to the guidance for electrical service connections at bchydro.com when applying for a new primary voltage electrical service connection or for alterations or upgrades to an existing primary service requiring an electrical permit per the *Safety Standards Act*. The customer's consultant should have the following information available for submission to a BC Hydro representative:

a. Site plans and drawings;

b. Motors 50 HP and larger in 12.5 kV areas and motors 100 HP and larger in 25 kV areas;

c. Loads that generate flicker, e.g. arc furnaces, chippers, crushers;

d. Preferred service type (overhead or underground); and

e. Completed BC Hydro *Electrical Service Information* form with the following minimum information:

   i. Total connected load in kVA and proposed transformer sizes;

   ii. Estimated total site load in kW per the BC Hydro *Electrical Service Information* form;

   iii. Emergency standby generators, as applicable;

   iv. Service address; and

   v. Planned in-service date.

5.1.2 BC Hydro Response

The BC Hydro representative will supply the customer with the following information:

a. Primary supply voltage. New primary service equipment shall be rated and certified for operation at 14.4/25 kV supply;

b. Service type (overhead or underground, radial or dual supply);

c. System impedance and available fault levels at the service point of connection (based on preliminary site plans and drawings);

d. BC Hydro terminal pole, switchgear kiosk, size of fuses or BC Hydro substation feeder relay settings;

e. Expected future primary feeder voltage upgrades;

f. Whether or not the proposed new load is acceptable from the existing distribution feeder or if system upgrades are required;

g. Designated space and registered statutory right-of-way on private property for installation of BC Hydro-owned equipment associated with the primary service; and

h. Customer emission study requirements (if applicable):

   i. Rapid voltage changes limits;

   ii. Flicker emission limits; and

   iii. Harmonic current limits.

5.2 Formal Application

5.2.1 Customer Submissions

The customer shall submit a formal application for installation, relocation, or alteration of a primary service. This includes work requiring an installation permit but excludes maintenance work done under an electrical operating permit provided it meets TSBC interpretation of 'maintenance on electrical equipment', per BCEC rule 2-300 and TSBC Directive D-E3 0708017 *Electrical Operating Permit Requirements*.

The formal application shall include the documents and drawings described in the following sections, authenticated by the POR.

Note 10: An incomplete application (including missing formal declarations) may delay the customer's service date. A BC Hydro representative will process the formal application and endeavour to respond within four weeks.

Note 11: Liability for the design and installation of customer-owned primary service equipment and materials rests with the customer's professional engineer and licensed electrical contractor.

Note 12: The application shall be submitted as a single bound PDF portfolio, with an itemized cover letter to ensure direct correlation between individual deliverables and the submission requirements outlined in section 5.2. Submission authentication shall be in compliance with EGBC authentication requirements.

The POR shall submit the following formal application documents before design completion:

a. Completed BC Hydro form *Checklist of Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV*;

b. Electrical one-line diagram including interrupting rating of protective devices and emergency standby generation as applicable per 5.2.2 Electrical One-Line Diagram;

c. Protective device coordination graph showing coordination between the customer and BC Hydro protective devices per 5.2.3 Protective Device Coordination Graph;

d. Site plan with equipment and primary vault locations, statutory rights-of-way, minimum clearances from the building, and primary conduit run as applicable per 5.2.4 Site Plan;

e. Completed BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* per 5.2.6 Primary Service Declaration;

f. Overhead line design showing the first customer pole and pole class, service switch and safety mat, fused cutouts and conductor separation at the crossarm, phase conductors, and neutral separation, in compliance with TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines* and 5.2.5 Primary Service Overhead Line Construction Details;and

g. Primary service equipment drawing (authentication not always required, see 5.3 Primary Service Fabrication Drawings Acceptance) including the loadbreak switch or circuit breaker, control wiring diagram, and key interlock scheme, if applicable. If such manufacturer drawings are not available, a BC Hydro representative may complete the review of an incomplete application. BC Hydro shall not authorize the customer primary service connection without accepting the primary service equipment fabrication drawings as outlined in 5.3 Primary Service Fabrication Drawings Acceptance. If submitting section 5.3 primary service fabrication drawings at a later date, the entire formal application must be resubmitted to maintain document alignment.

5.2.2 Electrical One-Line Diagram

Electrical one-line diagram submission requirements:

a. Be authenticated and submitted by a POR;

b. Show service entrance equipment including secondary metering, if applicable;

c. Show emergency standby generator connections;

d. Show surge arresters including ratings;

e. Indicate available fault levels at current or future operating voltage as applicable;

f. Show interrupting ratings of the overcurrent protection devices;

g. Include a legend clearly indicating device symbol and functionality; and

h. Emergency standby generator rating (e.g. kW, kVA) and associated transition transfer switch current rating (amp) and type (open or close) (see 3.9 Customer-Owned Standby Generation) as required.

See drawings PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* and PG A2-01 *One Line Diagram Dual Supply* in Appendix 1 List of Primary Service Requirements Standards for examples.

5.2.3 Protective Device Coordination Graph

Time-current characteristic curve submission requirements:

a. Be authenticated and submitted by a POR;

b. Use a standard 4½ x 5 cycle log-log graph for the coordination study. Ensure the service entrance protective device settings are compatible with, and properly coordinated to, BC Hydro protective equipment. (see 10 Primary Service Protection Requirements);

Note 13: BC Hydro may request the customer submit complex or illegible coordination graphs on 11" x 17" sheets instead of the standard 8½" x 11" sheets.

c. Use a unified time-current characteristic graph that overlays the upstream BC Hydro protection curves, customer relay or fuse entrance protection curves, and transformer magnetizing inrush points/curves;

a. Clearly indicate the time margins between BC Hydro protection devices and the customer's entrance protection for the maximum fault level and for any other fault conditions that result in the minimum allowable time margin (see 10.1.4 Interrupting Rating and Minimum Time Margins for minimum allowable time margins);

d. Clearly indicate maximum fault levels for bolted three-phase faults (LLL or LLG) and single line-to-ground faults (LG) without cutting the curves at those points; and

e. Use corresponding text boxes for each curve, providing curve details (relay manufacturer, pickup, time dial, curve type, curve modifiers, current transformer ratio, and delay). The customer's total clearing curve shall include the relay/control response time, breaker/recloser interrupting time, and all other propagation and power-up delays.

See drawing PG D1-01 *Sample Protection Curves Customer Services and BC Hydro* in Appendix 1 List of Primary Service Requirements Standards for an example protective device coordination graph.

5.2.4 Site Plan

Site plan submission requirements:

a. Be authenticated by the customer's POR;

b. Display all aspects of the primary service installation, covering both civil and electrical components, and indicate whether equipment is overhead or underground;

c. Clearly show the location of the building and primary service vaults, if applicable;

d. Identify the proposed terminal pole or service cable vault (manhole), and illustrate the route of the overhead line or underground cables on private property, including within the customer building, to the connection point, if applicable;

e. Indicate BC Hydro road access for line trucks to both the first pole and the primary revenue metering pole, if applicable;

f. Provide a detailed design layout of primary vaults or outdoor kiosks, if applicable that includes:

   i. Crew access and emergency egress routes;

   ii. Minimum operating clearances;

   iii. Safety grounding provisions; and

   iv. Proposed layout of primary service ducts, bends, fittings, and pull boxes, where applicable.

See 8 Primary Service Construction for more on underground service requirements.

5.2.5 Primary Service Overhead Line Design

Privately-owned primary service overhead line design submission requirements:

a. Be authenticated by a POR;

b. Reference standards: Designs shall not reference or include BC Hydro standards except where required as supply authority, such as for primary revenue metering;

c. Compliance: Design work shall comply with TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines*;

d. First customer pole: The first customer pole shall be a dedicated minimum class 2 free-standing pole or equivalent. The POR shall verify, through analysis compliant with CSA C22.3 No. 1, that the pole remains stable both with and without BC Hydro conductors attached. The first customer pole shall be double dead-ended and fitted with crossarms, a gang-operated loadbreak service switch, surge arresters, and fused cutouts. No additional customer equipment is permitted on the pole;

e. Revenue metering pole (when required): The revenue metering pole shall be a dedicated minimum class 2 pole or equivalent per BC Hydro ES43 overhead electrical standards. No additional customer equipment is permitted on the pole;

f. Pole mounting hardware and components on the first pole shall be certified to CSA C83 *Communication and power line hardware*;

g. Conductor arrangement: Clearly indicate conductor separation at the crossarm, phase conductors, and neutral separation;

h. Neutral attachment: Clearly indicate the neutral conductor attachment separation to ground; and

i. Device mounting: Clearly indicate fused cutouts (or recloser) mounting details and minimum clearances between devices on the pole.

To avoid project delays and field modifications of the customer-owned overhead line, the customer shall not commence construction until all drawings and information have been reviewed and accepted by a BC Hydro representative, typically within four weeks from the date of receipt. See Appendix 3 Photographs for a visual reference of overhead line construction examples.

5.2.6 Primary Service Declaration

The customer shall complete the BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* (also known as the primary service declaration). This form shall be authenticated by a POR.

5.3 Primary Service Fabrication Drawings Acceptance

The customer shall submit fabrication drawings for the proposed primary service switchboard or drawings for a proposed primary service kiosk to a BC Hydro representative for comment and acceptance prior to manufacturing. Fabrication drawings do not require authentication when the equipment is pre-certified by a certification agency for serial production.

To avoid costly changes and field modifications, manufacturing of the customer-owned equipment should not commence until all drawings and information have been accepted by the POR and a BC Hydro representative.

Note 14: Supply service cable pull boxes and primary service switchboard cells, cubicles, and compartments for the exclusive use of and with access restricted to BC Hydro personnel, shall be equipped with a padlocking hasp and BC Hydro security bolts, or other security restraining means with sealing provisions as determined by a BC Hydro representative.

The primary service switchboard or kiosk drawing shall show the following:

a. Fully dimensioned switchboard compartments and details, showing access doors and locking provisions;

b. Ground bus layout, equipment grounding pads, and grounding ball studs;

c. Primary service cable compartment and cable termination provisions (see BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*, and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*);

d. Main switch or a breaker switchboard compartment;

e. Circuit breaker and protective relaying wiring diagram, as applicable;

f. Interlocking diagram, equipment nameplates, and warning signs; and

g. Primary or secondary revenue metering compartment or switchboard compartment.

Contact a BC Hydro representative for further design and installation details and review the relevant BC Hydro distribution standards and other sections of this document.

5.4 High-Voltage Commissioning Report and Authorization for Connection

The customer shall submit a high-voltage commissioning report authenticated by a POR before the final connection authorization inspection, containing the following:

a. Grid potential rise and step-and-touch grounding report, when required by BCEC section 36 *High-voltage installations;*

b. Service switch or breaker commissioning report;

c. Protective relaying test report and a statement confirming the device margins indicated in 5.2.3 Protective Device Coordination Graph and trip time at maximum LG and LLL or LLG fault levels recorded by injecting primary or secondary test current;

d. Authenticated record drawings per 5.2 Formal Application and 5.3 Primary Service Fabrication Drawings Acceptance. Fabrication drawings per section 5.3 do not require authentication when the equipment is pre-certified by a certification agency for serial production;

e. A copy of the current-permit authorizing connection;

f. Contractor declaration as confirmation the primary service is completed in compliance with B.C. regulations and the *Safety Standards Act*; and

g. A letter from the POR stating submitted documents are in compliance with BCEC rules and BC Hydro requirements and meet the original design intent of 5.2 Formal Application as originally accepted by BC Hydro, or if different, indicate what changed and the reason for the deviations.

Note 15: The customer shall provide certified test results reviewed by a POR if used equipment is installed in the customer-owned primary service. The results shall authenticate the proposed equipment was tested in accordance with TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products* and is suitable for connection to the BC Hydro distribution system.

Note 16: The owner is responsible for damage to BC Hydro equipment resulting from a malfunction or improper installation of customer primary service equipment, including transfer switch and standby generator.

5.5 Primary Service Voltage Conversion Requirements and Procedure

See 3.8 Primary Service Voltage Conversion Requirements and Procedure.

5.6 Dead–Front Primary Services

See 9.19 Dead-Front Switchgear.

5.7 Temporary Power as Primary Service

Customer-owned primary services shall meet the requirements for BC Hydro primary distribution supply voltage and available fault level, overcurrent protection, potential rise of ground grid, and step-and-touch voltage requirements per BCEC section 36 *High-voltage installations*. A customer applying for connection of temporary primary service shall follow the steps and obtain necessary electrical permits, inspections, and approvals described in 5 Submission Procedures.

Note 17: A temporary service shall meet the requirements of this document applicable to permanent primary services.

6 BC Hydro Primary Distribution System

6.1 Preliminary Design

BC Hydro will determine the customer's service voltage.

6.1.1 Primary Supply Voltage

Almost all BC Hydro primary service connections are fed from the BC Hydro primary voltage distribution system, comprising a three-phase four-wire multi-grounded neutral system. Some smaller primary services may be supplied by single-phase two-wire multi-grounded neutral. BC Hydro primary distribution voltages are:

a. 4 kV: 2400 V / 4160 V grounded wye (legacy service, not for new construction);

b. 7.2 kV: single phase;

c. 12.5 kV: 7200 V / 12,470 V grounded wye;

d. 14.4 kV: single phase;

e. 25 kV: 14,400 V / 24,940 V grounded wye; and

f. 35 kV: 19,920 V / 34,500 V grounded wye (used in some rural applications in the Central Interior region of Northern B.C. and only available as overhead service).

System frequency is 60 Hz ± 0.1 Hz. Primary voltages may be designated in this document by their nearest whole number (e.g. a nominal voltage of 25 kV corresponds to 14,400 V / 24,940 V grounded wye).

6.2 Service Transformers

6.2.1 Primary Service Transformer Connections

The customer-owned transformer connections accepted by BC Hydro are:

a. Grounded wye to grounded wye (preferred configuration);

b. Delta to grounded wye;

c. Delta to resistance grounded wye;

d. Ungrounded wye to delta; and

e. Delta to delta.

6.2.2 Service Neutral Connections

The BC Hydro service neutral shall terminate at the service ground bus in the utility service entrance compartment in accordance with BC Hydro ES54 S3 underground civil primary services standards for indoor and outdoor primary service cable compartments.

6.2.3 Transformer Taps

BC Hydro recommends that customer-owned transformers use industry-standard two 2.5% primary taps above and below rated voltage. The BC Hydro system operates within the voltage range specified in CSA C235-83 *Preferred voltage levels for AC systems up to 50,000 V*. The use of taps on the customer's transformer will allow the customer to adjust the voltage as required at the point of utilization.

6.2.4 Maximum Connected Transformer Size and Limitations

Customer-owned transformer inrush current levels shall coordinate with the BC Hydro upstream protective device (recloser, fuse, or relay) during the energization transition period. Customers may be required to install equipment that mitigates inrush current where coordination with a BC Hydro upstream protective device is not achievable due to high transformer inrush current.

The customer service entrance protection shall coordinate with the upstream BC Hydro protective device. For specific large load customer coordination requirements, the customer consultant shall contact a BC Hydro distribution engineer for the service area.

7 Scope of Supply for Primary Services

7.1 BC Hydro Scope of Supply for Overhead Service Connections

BC Hydro normally supplies and installs the following for a primary overhead service connection:

a. Fused cutouts on the supply end of the primary service connection;

b. Fuse links for overcurrent protection of the BC Hydro primary service conductors, or solid links and BC Hydro feeder protective relaying for large primary services; and

c. Primary overhead service conductors and the primary service connection to the customer-owned loadbreak switch located on the first customer-owned pole.

Note 18: BC Hydro may install a dedicated recloser for improved service reliability for all customers and request the customer to coordinate new customer primary service protection relays with BC Hydro dedicated recloser relays.

Note 19 The location of the first customer-owned pole as the point of delivery shall be selected in agreement with BC Hydro. The pole lines on private property, riser/dip pole, and customer-owned unit substations are installed, owned, and maintained by the customer under the jurisdiction of TSBC or other authority having jurisdiction.

BC Hydro requirements on private property extend to the installation of primary or secondary revenue metering, which shall comply with BC Hydro metering requirements and 6 BC Hydro Primary Distribution System.

BC Hydro supplies the following equipment for installation by the customer's licensed electrical contractor:

a. An outdoor primary revenue metering cluster, complete with a pole-mounting bracket for primary revenue metering, two surge arresters for single-phase primary metering, and six surge arresters for three-phase primary metering; or

b. Switchgear secondary revenue metering transformers for secondary revenue metering.

Note 20: A pole-mounted overhead primary revenue metering kit is a costly option which will be charged to the customer as a cost-of-service connection. BC Hydro prefers secondary revenue metering, which is less costly and requires less maintenance.

7.2 Customer Scope of Supply for Overhead Service Connections

BC Hydro requires the customer to install the following materials and equipment for primary overhead services with pole-mounted primary revenue metering:

a. A loadbreak switch and safety ground mat on the first pole per drawing PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* (see Appendix 1 List of Primary Service Requirements Standards) and TSBC Directive D-E3 090313 1 *High voltage installations.* The loadbreak switch shall comply with 10.3.2 Loadbreak Switch;

b. Overcurrent protection by means of fuses or a circuit breaker on customer-owned unground service conductors, per BCEC rule 36-204 *Overcurrent protection*. A loadbreak switch requires fused cutouts on the first pole to meet the applicable rule;

Note 21: An exception to (b) applies if the customer chooses to install a utility-type recloser with the reclose function defeated as customer-owned overcurrent protection. BCEC rule 36-204 1 does not recognize a recloser as an acceptable means of providing overcurrent protection for a consumer service. In this configuration, a variance shall be obtained from TSBC and submitted to a BC Hydro representative to demonstrate authority having jurisdiction acceptance of this equipment. The recloser shall be installed on the second customer-

owned pole and the BC Hydro primary metering kit shall be installed on the third customer-owned pole (see drawing PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* in Appendix 1 List of Primary Service Requirements Standards). The customer could omit fuses on the first pole subject to a variance granted by TSBC.

c. A BC Hydro primary revenue metering kit on the second customer-owned pole, and completion of the primary line and load-side connections per BC Hydro ES43 J7 primary revenue metering standards; and

d. Surge arresters per 8 Primary Service Construction.

7.3 BC Hydro Scope of Supply for Underground Service Connections

BC Hydro will supply and install the following for underground primary service connections:

a. Primary supply service cables (pulled into customer-owned service ducts);

b. Cable support clamps;

c. Duct seals, as necessary;

d. Padlocks to secure utility-restricted equipment;

e. Equipment identification and safety decals;

f. Corresponding service cable terminations installed inside the utility supply service cable compartment of the customer-owned primary service switchboard as the point of connection; and

g. Grounding, bonding, and neutral connections for BC Hydro equipment (service cables and terminations).

BC Hydro will supply and install BC Hydro-owned and operated automated switches in areas designated by BC Hydro for underground primary open loop service for loads not exceeding 6.5 MVA in a 7.2/12.5 kV area, and a junction box for loads not exceeding 1.5 MVA in a 7.2/12.5 kV area. See BC Hydro standards ES54 E3-04 *Below Ground Switchgear BC Hydro Vault on Private Property,* ES54 E4-04 *Above Ground Switchear BC Hydro Vault on Private Property,* or ES54 E6-01 *BC Hydro Switchgear Vault in Customer-Owned Building Single Radial Supply*. The service connection for large customer loads or service requiring standby supply from another feeder shall follow BC Hydro standard ES54 E6-02 *BC Hydro Switchgear Vault in Customer-Owned Building Dual Supply*.

BC Hydro will supply the following equipment for installation by the customer's licenced electrical contractor for primary underground services:

a. Switchgear primary revenue metering transformers for the primary revenue metered service; or

b. Switchgear secondary revenue metering transformers for the secondary revenue metered service.

BC Hydro requirements on private property extend to the installation of primary or secondary revenue metering, which shall comply with BC Hydro revenue metering requirements and 6 BC Hydro Primary Distribution System.

Note 22: Revenue metering equipment and necessary conduits shall be installed by the customer. Control and interconnection wiring is supplied and installed by BC Hydro.

After receiving a formal application, BC Hydro will determine the most suitable form of underground service in consultation with the customer, based on the designated BC Hydro primary distribution circuit:

a. Single radial supply: Comprising the incoming cable termination and a gang-operated disconnect or loadbreak switch per drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* (see Appendix 1 List of Primary Service Requirements Standards). The maximum

transformer size is defined by the upstream protective device the transformer coordinates with (see 6.2.4 Transformer Taps); or

b. Primary service dual supply: Comprising two radial supplies per drawing PG A2-01 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* (see Appendix 1 List of Primary Service Requirements Standards). This configuration may be required for:

   i. High-reliability primary services with a standby feeder;

   ii. Large loads exceeding the limits stated in (a), in consultation with a BC Hydro representative; or

   iii. Other customer special requests (e.g. dedicated standby supply).

The procedure for transferring customers from the normal feeder to the standby feeder for primary service dual supply with one supply as standby involves momentarily paralleling both circuits in the customer's vault. Contact a BC Hydro representative for a detailed description of the switching procedure, which may require a distribution operating order.

7.4 Customer Scope of Supply for Indoor Primary Service Vaults

Service ducts (conduits), pull boxes, and pull pits on private property shall be designed and installed by the customer in accordance with BC Hydro ES54 section S underground civil service standards.

The customer shall supply and install the following, as applicable:

a. A primary service vault meeting the requirements of 8 Primary Service Construction;

b. A primary service vault access door key for direct exterior access per 8 Primary Service Construction;

c. Cable ducts, conduits, and fittings on private property per ES54 S0-05 *General Notes Service Ducts and Trenches*;

d. Engineered structural supports for the service cable ducts;

e. Metal cable pull boxes with hinged cover doors per 8 Primary Service Construction;

f. A remote shunt trip pushbutton and related accessories (e.g. tamperproof enclosure) per 8 Primary Service Construction;

g. A primary service switchboard meeting the requirements of 9 Primary Service Switchboard Construction; and

h. Surge arresters per 8 Primary Service Construction.

7.4.1 BC Hydro Supply Point Located Inside Customer Building

The customer shall construct an appropriately prepared electrical space for primary services requiring a BC Hydro switchgear room inside the customer building per BC Hydro standards ES54 E6-01 *BC Hydro Switchgear Vault in Customer-Owned Building Single Radial Supply* for single radial supply and ES54 E6-02 *BC Hydro Switchgear Vault in Customer-Owned Building Dual Supply* for dual supply.

The BC Hydro supply service cables shall run between the BC Hydro switchgear vault and the customer primary service vault as the BC Hydro supply point is located inside the customer building. These supply service cables are typically cut outside the building by BC Hydro crew and transported into the vault for installation by hand. BC Hydro can only deliver hand coils of cable due to the restricted height of 2.1 m, which limits the maximum service cable and duct length to 10 m. The customer primary service vault shall therefore be located within 10 m of the BC Hydro switchgear vault. If the customer locates a primary service vault more than 10 m from the BC Hydro switchgear room, BC Hydro requires a minimum vehicle access clearance of 4 m (13’1") to facilitate larger cable handling vehicles.

7.5 Customer Scope of Supply for Outdoor Primary Service Kiosks

Service ducts (conduits) and pull boxes on private property shall be designed and installed by the customer in accordance with BC Hydro ES54 underground civil construction standards and TSBC requirements or the *Safety Standards Act*, as appropriate, with reference to CSA C22.3 No. 7 *Underground systems*.

The extent of service cable runs on private property shall be kept to a minimum to reduce the possibility of cable damage and subsequent collateral supply disturbance to other services fed from the same circuit.

The customer shall supply and install the following:

a. A concrete pad for the primary service kiosk with duct window and conduit stubs located to align with the utility service cable compartment bus bars or service bushings;

b. A BC Hydro 832 box or 1232 box per 8 Primary Service Construction;

c. Primary service cable ducts and pull boxes located on the customer's property;

d. A primary service kiosk meeting the requirements of 9 Primary Service Switchboard Construction; and

e. Surge arresters per 8 Primary Service Construction.

7.6 Customer Scope of Supply for Primary Revenue Metering Kiosks

The customer may opt to install a primary service revenue metering kiosk outside their primary service vault or private overhead line as a designated demarcation structure and a point of connection, with BC Hydro's acceptance. This configuration may be suitable for distributed industrial plants with multiple distribution transformers or large strip malls, or for special installations requiring restricted access to BC Hydro personnel on private property.

A primary service metering kiosk shall include requirements and equipment listed in 7.5 Customer Scope of Supply for Ourdoor Primary Service Kiosks, with the addition of a primary revenue metering cubicle as described in 3.5 Revenue Metering. The revenue metering cubicle shall have a mechanical key interlock with a primary service main on the line side and on the customer switch, or a breaker on the load side as applicable, for safe access into the metering cubicle when the switches are locked out in the off position.

The customer shall supply and install surge arresters per 8 Primary Service Construction. Arresters shall be installed on the load side of the service main for the protection of BC Hydro revenue metering transformers.

8 Primary Service Construction

8.1 General

Customer-owned high-voltage installations shall comply with the applicable rules and regulations of TSBC, BCEC, and any other regulatory authorities having jurisdiction at the site in question. BCEC rules require the following:

a. Rule 36-000 *Scope*, paragraph (2): “The supply authority and the inspection department must be consulted before proceeding with any such installation”;

b. Rule 36-200 *Service equipment location*: “Service equipment shall be installed in a location that complies with the requirements of the supply authority and, in the case of a building, shall be at the point of service entrance”;

c. Rule 36-202 *Rating and capacity*, paragraph (b): “The type and ratings of circuit breakers, fuses, and switches, including the trip settings of circuit breakers and the interrupting capacity of overcurrent devices, shall be in compliance with the requirements of the supply authority for consumer’s service equipment”; and

d. Rule 84-002 *General requirement*: “The interconnection arrangements shall be in accordance with the requirements of the supply authority”.

BC Hydro primary distribution systems are engineered and constructed in accordance with authenticated BC Hydro distribution standards. Customer-owned primary services connected directly to the BC Hydro distribution system shall be engineered and certified to be compatible with the system. Certification shall include electrical equipment, support structures, the method of primary service connection, and service isolation, to ensure public safety and the safety of BC Hydro personnel. Customer-owned primary installations shall be installed by a class A licensed electrical contractor, registered and licensed by TSBC.

Note 23: BC Hydro may disconnect the primary service if customer-owned equipment poses a safety or operational risk to the BC Hydro distribution system, until the issue has been resolved to BC Hydro’s satisfaction.

Primary services shall be built to accommodate 14.4/25 kV primary supply, even if BC Hydro supply in the area may currently be 7.2/12 kV. This requirement is intended to minimize impacts related to future supply voltage conversion from 7.2/12 kV to 14.4/25 kV.

The customer shall install 18 kV rated surge arresters for 12.5 kV and 25 kV supply and 27 kV rated surge arresters for 34.5 kV rural supply to minimize the effect of transient switching surges and lightning strikes. The customer may choose to use 9 kV arresters for 12 kV supply but will require replacement with 18 kV for future 25 kV distribution feeder voltage upgrades.

Contact a BC Hydro representative for the service area for more information.

8.1.1 Underground Services

BC Hydro will supply and install primary service cables, cable terminations, and related accessories from the BC Hydro point of supply to the customer point of connection per 7.3 BC Hydro Scope of Supply for Underground Service Connections. New BC Hydro primary supply service cables are extruded dielectric. Paper-insulated lead-covered (PILC) cables are no longer installed for new supply service.

BC Hydro shall determine the number and size of cables and conduits required based on the information received about the load profile and size of the primary service. Contact a BC Hydro representative for detailed information about underground cables and installation costs.

8.1.1.1 Cable Protection

Utility supply service cables shall be housed entirely within ducts, utility-only access pull boxes, a restricted utility-only access cable pull pit, or a supply service cable compartment. Service ducts located on walls inside a building shall be concrete encased or protected by suitable metal covers.

8.1.1.2 Cable Terminations

BC Hydro will supply and install the following supply service cable terminations depending on the type of service equipment:

a. Live-front cable terminations for extruded dielectric cables, meeting the requirements of IEEE 48 *Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV* and BC Hydro equipment specifications; or

b. Dead-front 900 A separable insulated connectors, meeting the requirements of IEEE 386 *Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV* and BC Hydro equipment specifications per BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* or ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*, as applicable.

Note 24: Supply service cables shall enter the primary supply service cable compartment from the bottom. Cable terminations shall be installed and secured in an upright vertical orientation. BC Hydro will not accept inverted cable connections or inverted cable terminations.

8.1.1.3 Cable Support

The supply service cable compartment shall include a 1⅝" x"1⅝" C-channel mounted above the centreline of the supply service cable ducts to support the service cables positioned in the upward or forward (outward) facing orientation. The orientation shall be readily adjustable by the BC Hydro installer. The mounting provision attachment surface shall be aligned with the service duct and the contact surface of the service bus/bushings, and shall be adjustable from this point (minimum +15 mm forward and -75 mm backward). Cable support fixtures (cable clamps or cable positioning brackets) shall be supplied and installed by BC Hydro. The supply service cable compartment shall be designed and constructed in accordance with BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*, or ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*, as applicable.

8.1.1.4 Padlocks

BC Hydro standard padlocks have a ⅜" diameter shackle, 1" horizontal clearance, and 1" vertical clearance.

8.1.2 Overhead Services

BC Hydro is developing new standards for overhead primary customer-owned service connections, to be published in a future primary service requirements revision. In the interim, see 5.2.5 Primary Service Overhead Line Construction Details and 7.2 Customer Scope of Supply for Overhead Service Connections. BC Hydro's main safety concern is that customers supply and install new class 2 poles for the first service pole and primary revenue metering pole.

8.2 Service Ducts

Service ducts (conduits) on private property shall be installed by the customer in accordance with BC Hydro ES54 section S underground civil construction standards and the requirements of other authorities having jurisdiction at the site.

The extent of service cable runs on private property shall be kept to a minimum.

Figure 8-1 – BC Hydro underground duct marker board

Note 25: A BC Hydro representative may request the customer to install cable marker boards (Figure 8-1, 450 mm x 1000 mm x 12 mm) for any portion of the underground service duct run on private property with a high risk of future potential damage from dig-ins.

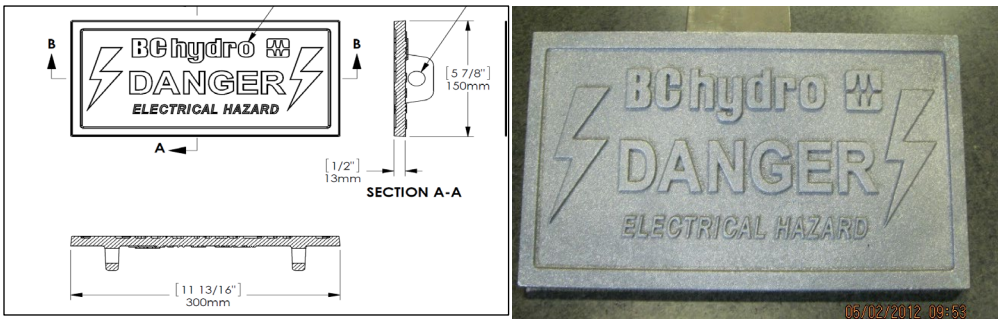


Figure 8-2 – BC Hydro primary cable warning plate

Note 26: Permanent cast iron warning plates (Figure 8-2) shall be installed for any portion of the primary service where ducts are embedded inside customer concrete building walls, floor slabs, or parkades. Warning plates are stipulated by BCEC rule 36-100 *Conductors*, paragraph (4), and shall be placed at intervals not more than 3 m. Cast iron warning plates are supplied by BC Hydro and are included as part of the primary service connection costs.

See BC Hydro ES54 underground civil construction standards for further design details.

8.2.1 Third-Party Cables

BC Hydro primary supply service cables and third-party communication cables shall be installed in separate ducts, maintaining the minimum separation clearance stipulated by CSA C22.3 No. 7 *Underground systems*.

8.2.2 Drainage

The customer shall ensure a downward sloping grade toward drain locations and provide proper drainage of the underground service entrance conduits on their property, including cable pits and pull boxes. BC Hydro will seal the service ducts at the first BC Hydro vault or other structure to help prevent entry of moisture and gases.

Note 27: The customer shall contact their local inspection authority and building department for drainage connection compliance.

8.2.3 Primary Service Ducts

The customer shall consult with BC Hydro to determine the number and size of primary service entrance conduits and design details of the ducts to be installed. Proper drainage shall be provided for each duct run.

BC Hydro construction standards for ducts inside a building are based on installing PVC type DB2 ducts, concrete encased, having 3" (75 mm) minimum concrete cover. BC Hydro disapproves of metal conduit as primary service duct but may accept this if mandated by the local authority having jurisdiction.

Ducts shall not pass through ferrous metallic structures in a manner that would induce eddy currents and result in heating of the service cables. The customer shall install 4" Hilti CFS-SL GA L firestop speed sleeves where BC Hydro exposed primary service cables pass through a fire-rated building wall or partition. One sleeve for each cable is required.

The design and construction of underground service ducts shall allow for safe and efficient installation and removal or replacement of primary service cables. The design shall ensure service duct lengths and cable pulling tensions are minimized to reduce the possibility of cable damage from excessive pulling stress, sidewall bearing pressure in bends, and abrasion caused by duct walls. A BC Hydro representative may require the installation of pull boxes at their discretion, particularly if:

a. The service run is longer than 50 m;

b. Cumulative duct bends exceed 135°;

c. Cable pulling tension exceeds acceptable limits; or

d. Other aspects of the proposed design require special consideration.

BC Hydro personnel use standard pulling equipment and mandrels best suited for the unrestricted conduit diameter. Conduits shall be installed using factory standard bends with a minimum 900 mm radius for 3" (75 mm) and 4" (100 mm) diameter ducts and minimum 1050 mm radius for 5" (125 mm) ducts. Duct end fittings shall be effectively sealed to prevent ingress of sand and other sedimentary materials depositing inside the ducts.

Note 28: BC Hydro does not accept thin-walled electrical metallic tubing conduits for BC Hydro service cables for installation inside a building or parkade.

Customer-installed service ducting shall be proven by having a suitable mandrel pulled through in the presence of a BC Hydro representative. Ducts shall be left with an acceptable new #8 polypropylene pulling string in place. Reused pulling string is not acceptable.

Service ducts shall be finished with an acceptable factory bell end inside pull boxes, pull pits, and kiosk pads.

8.2.3.1 Concrete Encasement

Service ducts specified for concrete encasement shall be PVC ducts and shall have concrete-tight couplings and fittings. The ducts shall be enveloped with a minimum concrete covering thickness of 75 mm and shall have a minimum separation, both horizontally and vertically, of 45 mm. The concrete shall be in accordance with the latest revision of CSA concrete standards (A23 series) and have a minimum strength of 20 MPa at 28 days.

If a service duct passes through or enters into a vertical concrete foundation wall, or if differential settlement might impose shear force on a service duct, the customer shall ensure a smooth transition to avoid damage to ducts and service cables. A BC Hydro representative may require the customer to provide an estimate of building structure settlement and required service cable slack. If differential settlement might occur, the customer shall submit an engineered design for concrete encased rebar-reinforced wall entry for service ducts to BC Hydro for acceptance. See BC Hydro standard ES54 S0-05-*General Notes Service Ducts and Trenches*

8.2.3.2 Structural Supports

Concrete encased PVC ducts inside a building shall be designed and constructed to support the weight of the concrete, ducts, and service cables, and to withstand all cable pulling forces (provided by a BC Hydro representative) during the installation and removal of service cables. Duct support structures shall be engineered.

8.3 Indoor Primary Service Vaults

All aspects of an electrical equipment vault, including but not limited to doors, ventilation, and drainage, shall be constructed in accordance with the BCEC, BC Building Code requirements, and applicable local bylaws per the authority having jurisdiction at the site.

8.3.1 Vault Location and Access

The vault shall be accessible to BC Hydro personnel via an exterior door located at grade, or vehicle access for a vault located in a parkade having minimum clearance of 2.1 m. Indirect access by building freight elevators or other methods is not acceptable to BC Hydro.

BC Hydro may accept a customer primary service vault design with a raised staircase from the vault floor as the only means of egress or emergency exit.

The vault for slab-on-grade buildings shall be located at the side or adjacent to the BC Hydro underground supply point. See BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*.

The customer shall locate the primary service vault for parkade-type buildings in agreement with a BC Hydro representative.

The vault location shall provide satisfactory access to allow unobstructed movement for equipment replacement and personnel access. Personnel access doorways shall be minimum 900 mm (3 ft) wide and equipment loading doors shall be minimum 1200 mm (4 ft) wide. A larger doorway may be required depending on equipment size. The vault door shall open outwards and include panic hardware.

8.3.2 Equipment Layout

The vault shall provide safe working space near the service entrance equipment, including metering provisions, in accordance with BCEC rule 2-308 *Working space around electrical equipment* and the BC Hydro document *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)*. BC Hydro requires a minimum 1.5 m clearance in front of the service cable compartment to apply safety grounds in accordance with BC Hydro work procedures. Adequate lighting shall be provided to allow for electrical equipment operation, inspection, and maintenance. Lighting shall be controlled by a wall switch located at the vault entrance.

Passageways and working spaces around electrical equipment shall not be used for storage. They shall be kept clear of obstructions and arranged to give BC Hydro ready access to the service entrance and metering compartments.

8.3.3 Cable Pull Pit

BC Hydro requires construction of cable pull pits for indoor vaults. Service entrance conduits shall terminate in a cable pull pit under the primary service switchgear cubicle unless otherwise advised by BC Hydro.

The pit shall have sufficient dimensions to accommodate a minimum 900 mm radius bend or as advised by a BC Hydro representative, to train the supply service cables into their compartment. The minimum length of the pull pit shall be 2100 mm from primary duct entrance wall to the opposing wall to accommodate cable pulling.

Cable pits shall extend outside the primary service switchgear to permit easy supply service cable installation. See BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation* for detailed requirements. The minimum angle for hinged covers shall not be less than 135°. A pull pit shall have at least one minimum clear access measuring 900 mm x 700 mm with the plates removed and shall not be considered a confined space. A BC Hydro representative shall review and accept customer submissions for cable pull pit and checker plate covers prior to construction, fabrication, and installation.

A solid concrete barrier is required through the full length of the pit if both BC Hydro and customer cables are located in the same cable pit, to provide complete physical separation.

Proper cable pit drainage shall be provided per 8.2.2 Drainage.

8.3.4 Indoor Pull Boxes

A metal pull box meeting the following requirements may be used for indoor pull box installations subject to acceptance by a BC Hydro representative per BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*:

a. Minimum 900 mm wide x 1800 mm high x 300 mm deep for top or bottom entry;

b. Minimum 900 mm wide x 1800 mm high x 750 mm deep for back entry. Pull box depth shall allow the minimum bending radius of BC Hydro service cables, which varies from 255 mm to 725 mm depending on cable size and design;

c. 1⅝" x"1⅝" C-channels to accept BC Hydro-supplied cable support and restraint hardware. Cable shall be supported at least every 1 m;

d. Pulling irons as shown in BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*;

e. A hinged cover door;

f. Shrouded penta bolts for installations outside the primary service vault; and

g. A padlock hasp and staple sub-assembly suitable for a BC Hydro padlock only. See 8.1.1.4 Padlocks for padlock specifications.

8.3.5 Remote Shunt Trip

The customer shall have a remote shunt trip operated by a maintained contact pushbutton located inside the building main entrance as required by the local fire marshal to facilitate emergency disconnection of customer primary service. The pushbutton shall be ¼-turn reset installed inside a tamperproof box next to the main fire alarm panel or as directed by the fire marshal. See 3.12 Fire Protection for shunt trip requirements.

A jointly operated customer primary service switch that is oil-filled or gas-filled shall have a remote shunt-trip pushbutton installed inside a tamperproof box hardwired to the service main trip coil to immediately trip the service. The pushbutton shall be located outside the primary service vault at a readily accessible location and shall be equipped with a staple and hasp for the installation of a BC Hydro padlock See 8.1.1.4 Padlocks for padlock specifications.

The shunt trip pushbutton shall have a dry-type contact hard-wired into the contactor/breaker trip coil and hard-wired interlock to prevent operation of the contactor/breaker close coil until the trip pushbutton is reset.

The remote shunt trip shall be supplied, installed, and connected by the customer.

8.3.6 Height

Vault height shall be minimum 2.2 m. The vault size and clearances shall meet the requirements of TSBC, BCEC, BC Building Code, and any other applicable requirements per local authorities having jurisdiction.

8.4 Outdoor Primary Service Kiosks

BC Hydro continues to work with equipment suppliers to install dead-front equipment for outdoor customer-owned primary service equipment for improved safety and reliability. See 9.1.9 Dead-Front Switchgear for a list of acceptable equipment suppliers.

BC Hydro no longer accepts concrete cable pull pits located below an outdoor primary service kiosk. Kiosks shall be installed in accordance with BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* or ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation* as applicable. A cable pull box shall be located per 8.4.1 Outdoor Pull Boxes, allowing adequate sealing of the service conduits and preventing ingress of earth gases into the service kiosk, which reduces component deterioration and extends the life expectancy of the service kiosk. Contact a BC Hydro representative for more information.

Outdoor service kiosks shall be an assembly that bears evidence of either a mark or label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by TSBC or other accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval, and installed on a customer-owned flat concrete pad with a cable duct window below a utility supply service cable compartment.

8.4.1 Outdoor Pull Boxes

BC Hydro may require installation of a concrete pull box equivalent to either a BC Hydro standard 832 box or 1232 box.

Note 29: Cable vaults (manholes) are not typically allowed as part of the customer's service as their classification as a confined space has operational impacts. While use of cable vaults is discouraged, special circumstances or conditions should be reviewed with a BC Hydro representative. Use of cable vaults is treated as a variance and will be evaluated at BC Hydro's sole discretion.

An 832 pull box with one riser shall be installed for 4/0 AWG (or smaller) supply service cables. A 1232 pull box with two risers (to accommodate a larger service cable bending radius) shall be installed for 500 kcmil and 750 kcmil sized supply service cables.

The pull box shall be located approximately 6.0 m from the outdoor primary service kiosk. Greater separation may be acceptable with the approval of the BC Hydro field manager. 832 and 1232 boxes shall be installed to accept a proprietary BC Hydro security bolt.

8.5 Equipment Identification and Safety Decals

BC Hydro will apply equipment identification and safety decals to the supply authority-related portions of customer-owned equipment to support the safe and reliable operation of the BC Hydro distribution system.

The customer's installation shall allocate adequate space for the necessary BC Hydro decals per the requirements of BCEC and local authority having jurisdiction bylaws. Clutter caused by placement of other non-critical unregulated decals and signs shall be minimized.

Decals shall be supplied and installed by BC Hydro. See Appendix 2 Reference Documents for decal examples.

9 Primary Service Switchboard Construction

9.1 General

Construction of the primary service switchboard shall comply with CSA C22.2 No. 31 *Switchgear assemblies.*

Note 30: The incoming switchboard compartment shall be designated as the customer service box and shall contain service fuses, a service switch or breaker, and associated relaying and power monitoring devices. Customer branch feeders and apparatus not related to the primary service supply shall not be installed inside the incoming customer primary switch compartment.

Switchboard compartments shall be constructed for easy supply authority access to components when required. Access to service cable terminations, loadbreak switches, disconnects (where required), and metering compartments shall be through hinged door panels securely fastened by bolting and locking (where applicable).

A separate heater power supply shall be provided downstream of the metering supply point where heaters are required to maintain temperature and control moisture inside switchboard compartments. Heaters shall be controlled by a humidistat and rated for 120 V minimum. See 7.5 Customer Scope of Supply for Outdoor Primary Service Kiosks for other requirements related to auxiliary equipment.

Main protection relays used on overhead and underground incoming supply may receive power downstream of the metering supply point.

Note 31: Spare fuses should be supplied and stored in a separate wall mounted cabinet accessible to operating personnel to minimize customer outage time caused by fuse operation. It is unacceptable to mount the spare fuses inside the switchgear fuse compartment if access to the spare fuses requires a power outage. The customer's licensed electrician is responsible for re-fusing customer equipment. This will not be performed by BC Hydro.

Paint the inside surfaces of compartments with viewing windows a light colour to aid visual inspection of switch and breaker status.

Door panels are access restricted to BC Hydro (supply authority), the customer, or jointly (BC Hydro and customer). BC Hydro restricted access door panels shall have only one locking point, a compatible hasp and staple subassembly, without any secondary lockable points such as lockable handle or shrouded penta bolt with padlock provision. Joint access door panels shall have two locking points, facilitated by a dual hasp and staple subassembly. No other locking points (e.g. lockable handle, shrouded penta bolt with padlock provision) are permitted.

9.1.1 Supply Service Cable Compartment

The supply service cable compartment shall be restricted to BC Hydro access only and reserved solely for mounting service cable terminations. The supply service cable compartment shall remain free of junction boxes, terminal blocks, surge arresters, and other ancillary devices. It shall not contain conductors not directly related to the equipment located in the supply service cable compartment (e.g. no gradient control conductors, control cables, secondary conductors).

BC Hydro requires a 3" x ¼" (76.2 mm x 6.4 mm) copper bus for terminating the neutral conductor, metallic cable shield(s), or concentric neutral conductors. See the BC Hydro ES54 S3 primary services standards for drilling patterns and spacing. 50 mm minimum clearance from compartment panels is required to provide clearance for field installation of threaded fasteners.

The service buses/bushings shall have a phasing arrangement of A-B-C, left to right.

9.1.2 Interlocks

Interlocks (padlocks are not acceptable) shall be provided between the service loadbreak switches, disconnect switches, and primary metering compartments in accordance with CSA C22.2 No. 31 *Switchgear assemblies*.

See BC Hydro drawing PG A2-02 *Dual Supply Service Four Key Interlock* in Appendix 1 List of Primary Service Requirements Standards for typical interlocking details for dual supply.

9.1.3 Dual Radial Primary Services

The service switchgear arrangement for existing dual radial primary services permits manual momentary paralleling of the two BC Hydro circuits during load transfer. Manual momentary paralleling of either of the two normal BC Hydro circuits and the standby circuit during load transfer is permissible for existing double dual radial services. Such operations shall only be performed by BC Hydro personnel. There are exceptions for customers to operate these switches under a special agreement with BC Hydro. See 9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference) and 9.4 Service Entrance Compartment Dual Supply.

9.1.3.1 Bolted Bus Bar Sections

Existing dual radial configurations where sections of bus are required to be bolted and removable for equipment maintenance purposes should have a sheet metal barrier available for insertion in the gap when bus sections are removed to help minimize customer outage time. The metal barrier shall be a slide-type and be suitably stored (fastened) in the loadbreak switch compartment when not in use. CSA standard phase-to-ground clearance shall be observed between the bus or component ends and the inserted metal barrier.

9.1.4 Outdoor Primary Service Kiosk Specific Requirements

BC Hydro requires the following for outdoor primary service kiosks:

a. “Shoebox” type door panels with neoprene gaskets; and

b. The external cover door shall be equipped with a padlocking hasp and staple subassembly compatible with a BC Hydro padlock. Penta bolts with welded pipe shrouds 34 mm in diameter (1 5/16") and 40 mm long (1 9/16") shall be included as required to secure each compartment.

9.1.5 Indoor Primary Service Specific Requirements

Access to indoor primary service vaults is restricted to qualified personnel. The utility service supply cable compartment door requires a 3-point latch and hasp for a BC Hydro padlock. Penta bolts and tamperproof shrouds are not required for indoor installations. No door is required on switchgear compartments with shared operating authority.

9.1.6 Sulphur Hexafluoride (SF_6) Filled Equipment

BC Hydro accepts SF_6 -insulated customer-owned primary service switchgear for indoor and outdoor installations for improved safety, reliability, and reduced cost of ownership. The switch and enclosure shall conform to the following requirements:

a. A certified test report including the initial volume of SF_6 gas, expected leakage rates, and proof of load make-and-break capabilities at expected end-of-life gas volume;

b. Switches with an integral filling port shall be equipped with a pressure indicating device for low SF_6 gas pressure and a warning sign placed on the equipment;

c. The service switch shall be equipped with integral viewing ports;

d. An integral grounding switch for each pole, mechanically interlocked to prevent direct switching from grounded to closed position; and

e. Screened and louvered ventilation ports on the front and back baseboards as a means of egress for leaking SF_6 gas, minimum 1 cm^2 port per 1 litre volume of SF_6 gas contained inside the switch.

9.1.6.1 Viewing Window

SF_6-insulated primary service switches shall incorporate integrated viewing ports to allow for visual inspection of the switch contacts, with moving and stationary contacts clearly visible, similar to BC Hydro standard dead-front switchgear. Viewing ports shall be accessible from ground level without the use of a ladder and shall be acceptable to BC Hydro.

Viewing ports shall be supplied complete with a self-closing arc flash cover and warning sign.

9.1.7 Additional Safety Requirements for Service Cable Compartments

A ball stud shall be permanently mounted on each phase bus bar (for live-front switchgear) and on the equipment ground bus in a supply service cable compartment, as required by WorkSafeBC and BC Hydro work procedures for installation of personal protective grounding. Ball studs shall be positioned to accept universal grounding ball clamps operated with hot sticks.

BC Hydro requires the extension of a ground bus and seven grounding ball studs in a primary revenue metering cubicle. There shall be one grounding ball stud on either each side of three current transformers and one grounding ball stud bolted to the ground bus (see BC Hydro revenue metering requirements on the BC Hydro website).

BC Hydro has recorded numerous safety failure incidents of cast and drop-forged grounding ball studs when installing safety grounds. These incidents have led BC Hydro to phase out cast and drop-forged ball studs and to only accept machined ball studs for new installations. Table 9-1 shows the grounding ball studs that BC Hydro accepts.

Table 9-1 – Acceptable ground ball studs

Manufacturer	Part number
MacLean Power Systems	HC 30029-1
MacLean Power Systems	HC 30029-2
MacLean Power Systems	HC 30029-3.5
Prime Engineering	GBS-01 Assembly_4.0
Prime Engineering	GBS-07 Assembly_4.1

9.1.8 Live-Front Switchgear

BC Hydro personnel require safe access to a customer-owned supply service cable compartment and instrument transformer compartment. BC Hydro personnel shall be able to complete a visual inspection of the primary service visible disconnection point (e.g. isolation switch open and switch blades pulled down from the line contacts above). BC Hydro accepts draw-out switchgear for customer-owned primary services with oil-filled or vacuum circuit breakers or switches as the disconnecting device. These disconnecting devices may be preceded with an air-insulated disconnect switch as an acceptable safety barrier and visible disconnection point.

Note 32: Open contacts inside an oil-filled circuit breaker or vacuum bottle are not an acceptable isolation point for safe access to a supply service cable compartment or instrument transformer compartment.

Exposed cable connections and buswork inside the primary service cable compartment shall be covered with removable insulation barriers to prevent accidental contact with energized live parts per WorkSafeBC

requirements, BC Hydro work procedures, and regulations governing the limits of approach. The buswork may be covered with rated polymer-based material, while cable connections and grounding balls may be covered with adequately rated removable insulation boots. See BC Hydro standards ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation* and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*, and Figure A3-1 *BC Hydro utility service cable compartment* in Appendix 3 Photographs for design and installation details.

9.1.8.1 Viewing Window

Viewing windows are required for safety reasons to enable BC Hydro personnel to determine the status of switches and circuit breakers (see 'Visible disconnection point' in 2 Definitions). The windows shall be wired glass or heat-tempered plate glass, and shall be sized and positioned so a viewer can conveniently observe switch blade status with the access door closed. A viewing window for an indoor-type air-rated switch shall have minimum dimensions of 250 mm x 380 mm. Viewing windows shall be accessible from ground level without the use of a ladder and shall be acceptable to BC Hydro. The use of cameras is not acceptable.

Viewing windows shall be supplied complete with a self-closing arc flash cover and warning sign.

9.1.8.2 Operating Handle

The height of the operating handle pivot point for loadbreak switches operated by BC Hydro personnel shall be 1.5 m or less above the vault floor.

A guard shall be provided if a chain is used between an operating handle and a loadbreak or disconnect switch so that if the chain breaks it will not contact any live parts.

9.1.9 Dead-Front Switchgear

See BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation,* and photographs in Appendix 3 Photographs.

BC Hydro continues to improve the safety of primary service connections through field evaluation and acceptance of dead-front switchgear designs for customer-owned primary services. Due to the design of dead-front switchgear there is no access to the high-voltage conductors, so the service bushings shall be grounded via the customer's loadbreak grounding switch to comply with BC Hydro work procedures. BC Hydro assumes operating authority over a shared or dedicated switch (depending on equipment design) to facilitate this requirement.

Table 9-2 shows acceptable customer-owned dead-front primary service equipment for indoor and outdoor applications. Though this equipment has been evaluated and field-validated by BC Hydro to be acceptable for use, each specific application shall be accepted by a BC Hydro representative.

Table 9-2 – Acceptable customer-owned dead-front primary service equipment

Manufacturer	Equipment configuration	Acceptable for indoor applications	Acceptable for outdoor kiosk applications
Eaton / Cooper Power Series / Cooper Power Systems	Fluid-insulated shared loadbreak grounding switch mechanically interlocked with relay-controlled vacuum fault interrupter	Yes	Yes
Power Systems Technology (PST)	MiniSub SF_6-insulated switchgear with shared loadbreak grounding switch and relay-controlled vacuum fault interrupter	Yes	Equipment under evaluation

Manufacturer	Equipment configuration	Acceptable for indoor applications	Acceptable for outdoor kiosk applications
S&C Electric Co.	Vista model 211 SF_6-insulated switchgear with dedicated supply authority loadbreak grounding switch and dedicated customer interrupter	Yes	Yes

See Appendix 3 Photographs for photographs of typical equipment application. Dead-front equipment is consistent with BC Hydro work methods and provides an additional safety barrier. BC Hydro Distribution Standards continues to work with manufacturers toward BC Hydro acceptance of additional dead-front equipment designs.

Following is a list of specific requirements for dead-front customer-owned primary service equipment. All other relevant requirements of this document also apply. This list may not be definitive. Requirements are applied in conjunction with a comprehensive evaluation process conducted by BC Hydro:

a. Indoor service switchgear shall comply with the BCEC for installation of fluid-filled equipment or SF_6-insulated equipment, as appropriate;

b. Dead-front primary service equipment shall be equipped with viewing ports, meeting the requirements of 9.1.9.1 Viewing Window;

c. Equipment shall be in three-phase configuration;

d. The supply service cable compartment shall have access restricted to BC Hydro personnel only with a metal barrier to partition it from other areas of the switchboard. Removal of the threaded fasteners securing the barrier shall require access to the supply service cable compartment;

e. Access provisions for the supply service cable compartment and switch compartment may incorporate bolted removable panels in addition to a padlocked hinged door as a single assembly. The access door and panel assembly need not be full height (i.e. 80");

f. The switch compartment for outdoor switchgear installations requiring shared operating authority between BC Hydro and the customer shall be equipped with a double hasp and staple subassembly for installing BC Hydro and customer locks independently;

g. The service switch shall have an integral ground position configured to allow service bushing grounding. The switch shall be lockable in the ground position using a BC Hydro padlock. It shall be possible to block the switch from being placed in the grounding position with a BC Hydro padlock;

h. The service switch shall allow locking in the open position using a BC Hydro padlock;

i. The service bushings shall be 900 A deadbreak interface (copper contact), 25 kV class, and meet the requirements of IEEE 386 *Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV*;

j. A capacitive-type voltage indicator shall be installed between each service bushing and the service switch as a live line indicator at the service bushing;

k. A key interlock for revenue metering compartment access for switchgear with separate customer and supply authority switches (i.e. dead-front switchgear) shall be installed on the customer's switch only;

l. Switchboard design shall meet the requirements of BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* or ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation* as applicable; and

m. Compartment doors and panels shall be large enough and unencumbered by manufacturer and customer markings to accommodate BC Hydro equipment marking decals.

9.1.9.1 Viewing Window

Switches shall incorporate integrated viewing ports to allow for visual inspection of the switch contacts, with moving and stationary contacts clearly visible, similar to BC Hydro standard dead-front switchgear. Viewing ports shall be accessible from ground level without the use of a ladder and shall be acceptable to BC Hydro. The use of cameras is not acceptable.

Viewing ports shall be supplied complete with a non-removable self-closing arc flash cover and warning sign, unless the switch is internally mechanically interlocked with a downstream protective device so it cannot be operated under load.

9.1.10 Unacceptable Equipment

BC Hydro will neither accept nor operate customer-owned loadbreak elbow cable terminators.

Primary service kiosk designs with an integral oil-immersed loadbreak switch housed in a separate compartment attached to the transformer tank as a primary service switch do not comply with BC Hydro work methods or with this document.

Note 33: A limited number of customer-owned primary service kiosks with loadbreak elbows and oil-immersed service switches were installed in the past under special local operating order provisions. These types of installations are no longer acceptable to BC Hydro.

9.2 Service Entrance Compartment Single Radial Supply

Separate compartments are required for service cable terminations and the customer's loadbreak switch in the service entrance compartment for single radial supply service:

a. Loadbreak switches and fuses shall be installed in separate compartments;

b. Proper termination space and cable supports shall be provided as detailed in BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*, and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*. BC Hydro height requirements can be met by using base spacers separated to match each enclosure to increase the cable termination height; and

c. Key interlocks shall be provided between the loadbreak switches and fuses so the fuse compartment cannot be opened unless the loadbreak switches are locked open.

See drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* in Appendix 1 List of Primary Service Requirements Standards.

Note 34: BC Hydro personnel rely on a class A electrician working for the customer to operate customer-owned equipment for single radial supply. BC Hydro will not operate customer live-front equipment. BC Hydro may operate customer dead-front equipment from closed to open, open to ground, and ground to open when required to support BC Hydro’s work. The customer’s electrician is responsible for closing the switch and restoring service to the customer’s facility. Viewing window and switch operating handle locations shall meet applicable CSA standards and requirements of the local inspection and regulating authorities.

9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference)

9.3.1 Existing Dual Radial Building Services

Existing dual radial service entrance equipment shall have an arrangement and layout that allows safe servicing and replacing of the following service entrance switchgear components with minimum interruption of service:

a. Service cable termination;

b. Service disconnect switch; and

c. Service loadbreak switch or breaker.

This shall be made possible by the operation of switches and mechanical removal of bolted bus bar sections. A brief outage will be required to allow safe isolation of the components for servicing.

For existing dual radial supply switchboards:

a. Cable terminations, disconnect switches, loadbreak switches, and the fuse/circuit breaker shall be installed in separate compartments connected by bus bar sections (removable bus links as required);

b. Viewing windows shall be provided;

c. Provision shall be made for padlocking the loadbreak and disconnect switches with BC Hydro standard padlocks when the switches are in the open position; and

d. Dual supply switches, forming a part of the customer-owned switchgear, shall be equipped with acceptable locking provisions for restricted access and operation by BC Hydro personnel only.

Note 35: Dual radial supply customer-owned switches and associated equipment shall be maintained by the customer in accordance with regular maintenance notices issued to the customer by BC Hydro. See BC Hydro standard ES 64-C-03.06 *BC Hydro Distribution Inspection* and *Maintenance Standard Dual Radial Vault Inspection/Maintenance Certification* in Appendix 2 Reference Documents.

9.3.2 Existing Dual Radial Building Service Upgrade

If customers choose to update their primary service, the new equipment must be rated for 25 kV to align with BC Hydro's future plans for 25 kV rated distribution feeders to double the energy capacity. Customers, in consultation with BC Hydro, should assess whether their building can be converted to single radial or open loop supply. If conversion is not feasible, customers can work with consultants to design a dual radial system using 25 kV-rated 3-way switchgear. Additional standards will be outlined in future revisions of this document.

Figure 9-1 – Old 12.5 kV dual radial switchgear next to new 3-way dead-front switchgear

9.4 Service Entrance Compartment Dual Supply

Dual supply service entrance equipment shall meet the requirements of 9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference). See drawing PG A2-02 *Dual Supply Service Four Key Interlock* in Appendix 1 List of Primary Service Requirements Standards and BC Hydro standard ES54 E6-02 *BC Hydro Switchgear Vault in Customer-Owned Building Dual Supply* which show a typical layout and configuration of primary service connections and BC Hydro requirements.

Provision shall be made for padlocking the loadbreak and disconnect switches and tie switch with BC Hydro standard padlocks when the switches are in the open position.

10 Primary Service Protection Requirements

10.1 Equipment Rating

10.1.1 Current

Equipment shall be rated in accordance with applicable CSA standards.

10.1.2 Voltage

Equipment shall be rated to BC Hydro's system voltage.

Note 36: If service entrance equipment is installed in an area scheduled for future voltage conversion to 25 kV, provisions shall be made for the equipment to operate at 25 kV with minimal modifications. Equipment for 25 kV conversion not in use at 12 kV shall be stored in a clearly labelled and accessible compartment.

10.1.3 Basic Impulse Level

The minimum basic impulse level (BIL) rating requirement for customer-owned equipment is:

a. 60 kV on the 4.16 kV system;

b. 60 kV on the 7.2 kV system;

c. 95 kV on the 12.5 kV system;

d. 110 kV on the 14.4 kV system;

e. 125 kV on the 25 kV system; and

f. 150 kV on the 34.5 kV system.

10.1.4 Interrupting Rating and Minimum Time Margins

Table 10-1 shows the minimum fault interrupting rating, fault closing, and withstand and short circuit bracing requirement for the customer's service main.

Table 10-1 – Interrupting rating and fault closing

Type of service	Interrupting rating		
	Circuit breakers / reclosers (MVA)	Fuses and fuse links	
		Asymmetric root-mean-square (Amps)	Symmetric root-mean-square (Amps)
4.16 kV, three-phase 4-wire	50	12,000	7,500
12.5 kV, three-phase 4-wire	250	20,000	11,500
25 kV, three-phase 4-wire	500	20,000	11,500
34.5 kV, three-phase 4-wire	300	9,000	5,000

The customer shall coordinate their primary service overcurrent protection with BC Hydro's upstream protection devices. BC Hydro is responsible for identifying the upstream protection device and communicating protection and fault levels at that location to the customer.

Minimum time and current separation between the customer's service main protection and BC Hydro protection devices will vary depending on the types of protective devices but shall not be lower than the

minimum values defined in Table 10-2 and accompanying notes. An option for a reduced minimum time margin for customer relay/recloser protection is available if both the customer's response time curve and total clearing time curve are shown on the time-current characteristic graph. The total clearing curve shall include the maximum relay/control response time, breaker/recloser interrupting time, and all other propagation and power-up delays required to clear the fault. Breaker/recloser commissioning test results and protection relay test results including trip times at maximum LG and LLLG faults shall be provided to validate reduced time margin proposals.

Table 10-2 – Minimum separation of protective device time-current curves

BC Hydro protection	**Customer entrance protection minimum time and current margins**		
	Fuse	**Digital relay / digital recloser control**	**Electromechanical relay**
Fuse	Current margin: +10% see note 6 Time margin: 2 cycles (0.033 s) see note 1	Current margin: +20% see note 5 Time margin: 12 cycles (0.2 s) see note 2 or reduced time margin: 3 cycles (0.05 s) see note 4	Current margin: +20% see note 5 Time margin: 18 cycles (0.3 s) see note 2 or reduced time margin: 6 cycles (0.1 s) see note 4
Electromechanical relay	Current margin: +10% see note 6 Time margin: 18 cycles (0.3 s) see note 3	Current margin: +20% see note 5 Time margin: 18 cycles (0.3 s) see note 2 or reduced time margin: 6 cycles (0.1 s) see note 4	Current margin: +20% see note 5 Time margin: 18 cycles (0.3 s) see note 2 or reduced time margin: 6 cycles (0.1 s) see note 4
Digital relay	Current margin: +10% see note 6 Time margin: 12 cycles (0.2 s) see note 3	Current margin: +20% see note 5 Time margin: 12 cycles (0.2 s) see note 2 or reduced time margin: 3 cycles (0.05 s) see note 4	Current margin: +20% see note 5 Time margin: 18 cycles (0.3 s) see note 2 or reduced time margin: 6 cycles (0.1 s) see note 4
Recloser	Current margin: +10% see note 6 Time margin: 12 cycles (0.2 s)	Current margin: +20% see note 5 Time margin: 12 cycles (0.2 s) see note 2 or reduced time margin: 3 cycles (0.05 s) see note 4	Current margin: +20% see note 5 Time margin: 18 cycles (0.3 s) see note 2 or reduced time margin: 3 cycles (0.05 s) see note 4

Table 10-2 notes:

1. Time margin is applied between the customer fuse maximum clear curve and the BC Hydro minimum melt fuse curve, up to and including the maximum fault level. For an example see drawing *PG D1-01 Sample Protection Curves: Customer and BC Hydro Fuses* in Appendix 1 List of Primary Service Requirements Standards. The following remedies may be considered by the customer to achieve acceptable coordination if this time margin cannot be achieved due to high fault current:

   a. The customer can provide instantaneous protection by using a relay/recloser arrangement. The relay/recloser to fuse minimum time margins in Table 10-2 would still apply.

b. The customer may choose the proper fuse type for fuse-fuse coordination that best coordinates with the current BC Hydro protection device.

c. The BC Hydro protection fuse may be increased provided proper coordination with the upstream protection device can be achieved.

2. Time margin is between the customer relay/recloser response curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve.

3. Time margin is between the customer fuse total clear curve and BC Hydro relay/recloser response curve. For an example see drawing PG D1-03 *Sample Protection Curves: Customer Fuse and BC Hydro Recloser* in Appendix 1 List of Primary Service Requirements Standards.

4. Reduced time margin is between the customer relay/recloser total clearing curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve. Both the customer's response time curve and total clearing time curve shall be shown on the time-current characteristic graph. The customer's total clearing curve shall include the maximum relay/control response time, breaker/recloser interrupting time, and all other propagation and power-up delays required to clear the fault. For an example of a time-current coordination plot see drawing PG D1-02 *Sample Protection Curves: Reduced Margin Between Customer Relay and BCH Relay* in Appendix 1 List of Primary Service Requirements Standards.

5. Current margin is between the customer relay/recloser response curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve. The margin is applicable between the customer curve's current pickup and up to either the customer's instantaneous pickup or the maximum fault level, whichever occurs first, for the applicable protection element (e.g. 51P phase element from pickup to either 50P instantaneous pickup or the maximum fault level the phase element would react to). There are separate current margin requirements for instantaneous elements (see section 10.2.2 Relays). For an example of a time-current coordination plot see drawing PG D1-02 *Sample Protection Curves: Reduced Margin Between Customer Relay and BCH Relay* in Appendix 1 List of Primary Service Requirements Standards.

6. Current margin is between the customer fuse total clearing curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve. The margin is applicable throughout the fuses current range up to the maximum fault level. For an example see drawing *PG D1-01 Sample Protection Curves: Customer and BC Hydro Fuses* in Appendix 1 List of Primary Service Requirements Standards.

10.2 Protection with Relays and Circuit Breakers

10.2.1 Location of Current and Potential Transformers

Current and potential transformers used for relaying, protection, or live line indictors may be located on either side of the circuit breaker or a customer-owned service isolation device (e.g. isolation switch, loadbreak switch). Unmetered potential transformers shall not be used for any power supply.

Under no circumstances shall the customer install potential transformers or current transformers in the utility service cable compartment.

10.2.2 Relays

BC Hydro does not require testing and approving of the customer's service entrance protective relays provided they meet minimum requirements specified in IEEE C37.90 *Standard for Surge Withstand Capabilities (SEC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus*. BC Hydro requires the customer to carry out a commissioning test to verify their relays perform as specified, including a primary or secondary injection test (pick-up, reset, and timing) and tripping test. A copy of the relay commissioning report, signed by a professional engineer, shall be submitted to BC Hydro prior to energization, as stated in 5.4 High-Voltage Commissioning Report and Authorization for Connection.

Note 37: BC Hydro may request the customer have protective relay tests for special applications or a particular service failure, performed by an independent test facility (e.g. Powertech Labs Inc.) for acceptance by a BC Hydro accredited representative.

Overcurrent relays may be a single microprocessor-based multi-function relay, or, for existing older protection installations, multiple relays arranged as three-phase relays, or as two-phase relays and one ground relay. The microprocessor-based relay is preferable and may be required for larger installations for coordination with BC Hydro ground or negative sequence relay elements. The ground relay can be as sensitive as unbalanced loading and inrush will permit.

The minimum separation between characteristics of the customer's relay and the BC Hydro protection system at the customer's installation for all currents between the pickup(s) and the maximum fault current, shall be maintained as described in Table 10-2. Differential relay protection on the customer's main breakers shall be accompanied by overload protection. Differential relay protection alone is not acceptable.

Customer relay protection should be capable of instantaneous phase and ground tripping. A protection relay response below two cycles achieved above an adjustable current pickup threshold is accepted as instantaneous. The instantaneous element current pickup threshold should be set at:

a. Not higher than 80% of the BC Hydro instantaneous element current pickup (if existing); and

b. Lower than the fault current for which the coordination time margin described in Table 10-2 cannot be achieved. BC Hydro may approve, on a per-application basis, simultaneous clearing between the customer’s instantaneous element and BC Hydro protection system, at high fault levels larger than the customer’s instantaneous overcurrent pickup.

It is recommended that customers use separate phase and ground relay curves when the upstream BC Hydro protection device is a relay, recloser, or dead-front switchgear (see drawing *PG D1-02 Sample Protection Curves: Reduced Margin between Customer Relay and BC Hydro Relay* in Appendix 1 List of Primary Service Requirements Standards for an example curve plot).

Consideration should be given for load growth within the confines of the service agreement, and cold load pickup when selecting the customer’s entrance protection pickup. Total facility loading may be a technical limitation for the customer’s entrance protection design under cold load pickup conditions.

Note 38: BC Hydro may request the customer provide an updated authenticated protective relay test report and sealed coordination diagrams for existing installations, or a particular primary service failure, if the most recent report and diagrams are more than five years old.

10.2.3 Circuit Breakers

Circuit breakers shall have a maximum interrupting time of five cycles. Circuit breakers may be equipped with an AC trip coil or DC voltage shunt trip coil. The customer is responsible for maintaining the battery supply if a DC trip is used. If a stored energy voltage trip scheme such as a capacitor trip is applied, the voltage supply for charging the capacitors may come from the source side of the associated circuit breaker.

A fixed-type circuit breaker as a service main shall be equipped and interlocked with a service disconnect switch as shown in drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* (see Appendix 1 List of Primary Service Requirements Standards).

A draw-out circuit breaker as a service main equipped with lockout and grounding provisions in a draw-out position is acceptable.

A utility type recloser programmed for single shot operation is acceptable to BC Hydro as a service main circuit interrupter provided it is accepted by the electrical inspection authority having jurisdiction. See note 21 for this configuration.

10.3 Protection with Fuse and Loadbreak Switch

10.3.1 Fuse Size

Fuses shall have time-current characteristics that coordinate and provide fully selective clearing with the upstream BC Hydro protective device. The customer shall consult a BC Hydro representative for BC Hydro upstream protective device details for a particular primary service connection during preliminary design (see 5.1.2 BC Hydro Response).

It is not feasible to prepare a table of fuse sizes for each transformer connection. The following general design criteria provide guidance:

a. The fuse shall be sized as small as possible and shall conform with the BCEC;

b. The fuse shall withstand magnetizing inrush current, which varies from 8 to 12 times the rated current of oil-filled transformers for 0.1 to 0.2 seconds. The transformer design greatly affects the magnitude of the inrush current;

c. Short circuit withstand and overload ratings shall exceed the fault currents listed in Table 10-1;

d. The fuse shall coordinate with the BC Hydro upstream protective device with margins at or greater than the minimum times listed in Table 10-2; and

e. Consideration should be given for load growth within the confines of the service agreement, and cold load pickup when selecting the customer's entrance protection pickup. Total facility loading may be a technical limitation for the customer's entrance protection design under cold load pickup conditions.

See the PG D1 sample protection curve drawings in Appendix 1 List of Primary Service Requirements Standards for further reference.

Drawing PG D2-01 *Type T Fuse Time-Current Curves* shows BC Hydro's preferred type T fuse curves. The PG D3 drawings show the time-current curves for BC Hydro's typical type E standard speed fuses. See Appendix 1 List of Primary Service Requirements Standards for these drawings.

10.3.2 Loadbreak Switch

A customer-owned loadbreak switch installed as a primary service main switch shall have the following minimum current ratings:

a. Load breaking current of 200 A; and

b. Fault closing current withstand of 22 kA lasting 10 cycles.

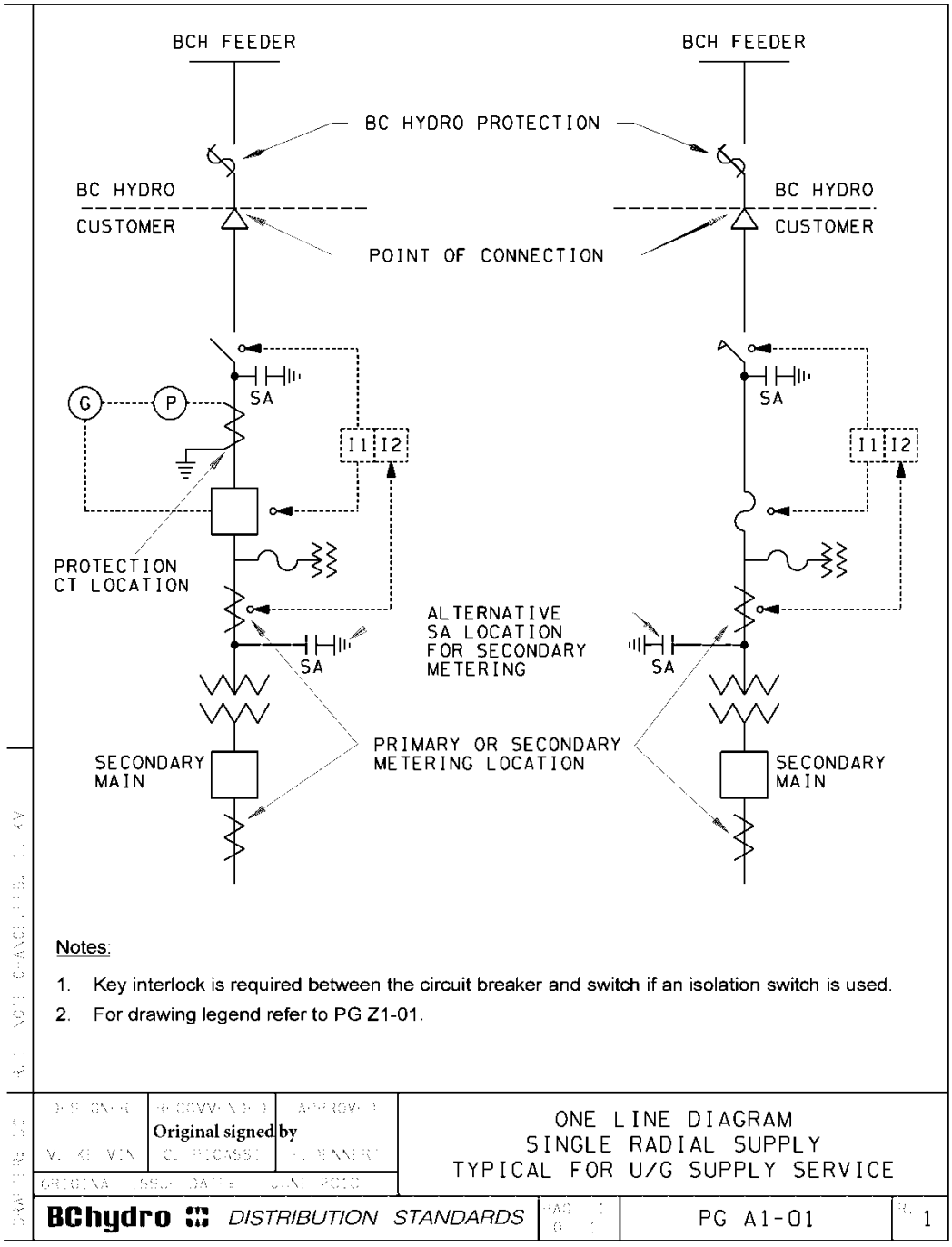
The use of customer-owned loadbreak switches as a primary circuit opening device for secondary ground fault protection is not acceptable for any type of customer-owned primary service applications.

Appendix 1 List of Primary Service Requirements Standards

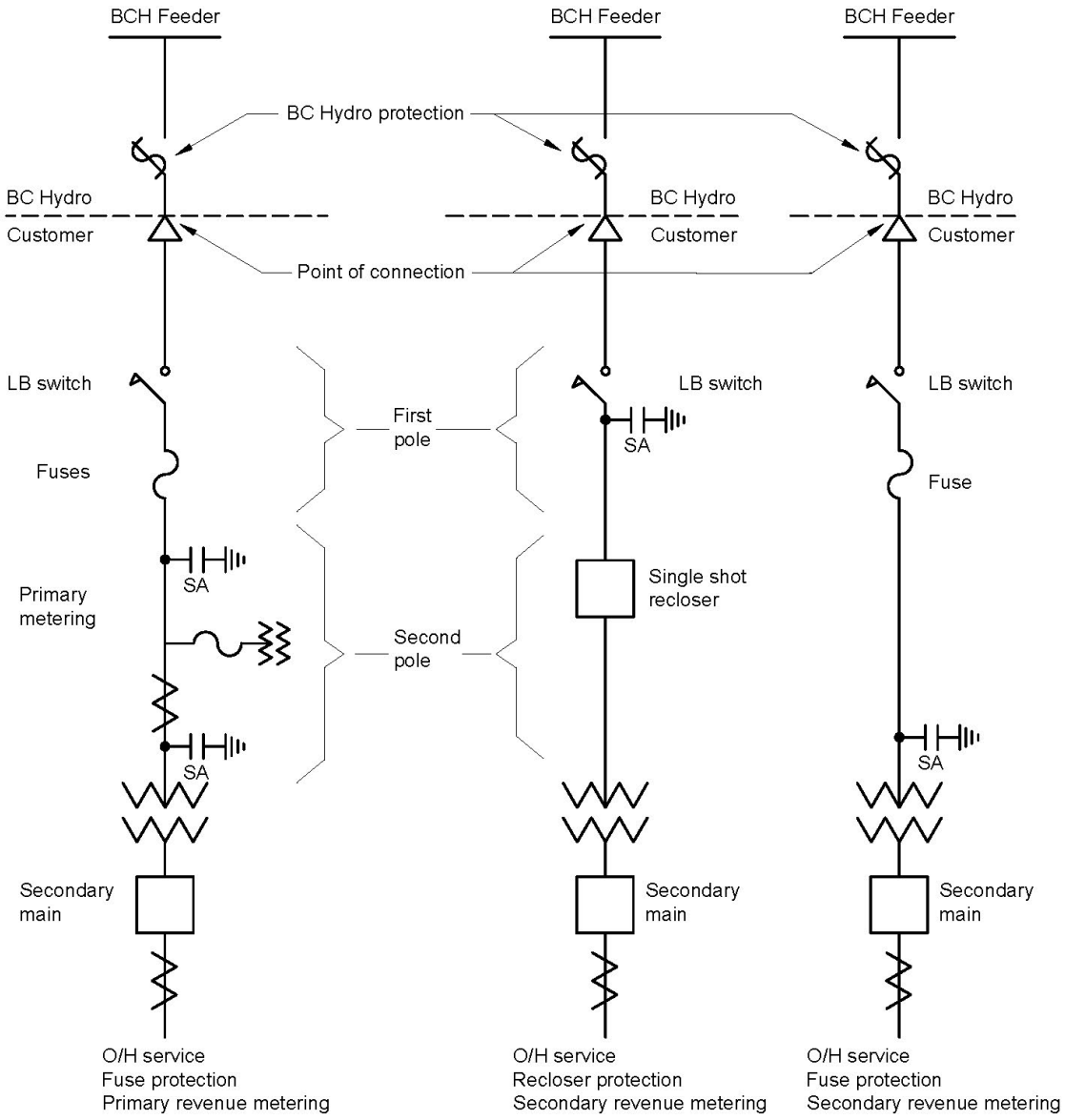
Persons using this manual are responsible for ensuring the following reference documents are the most recent versions.

Appendix Contents

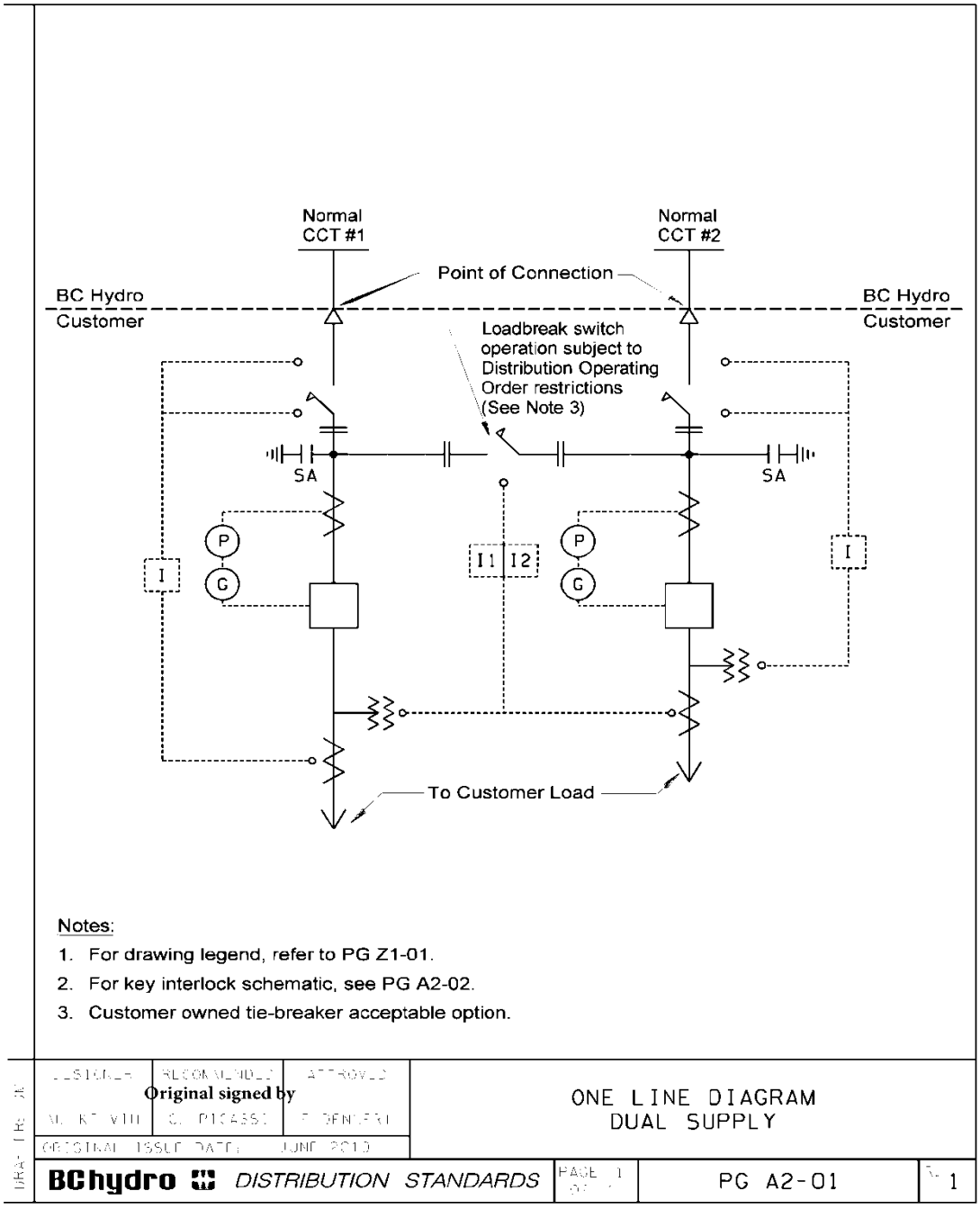
A Electrical Schematics



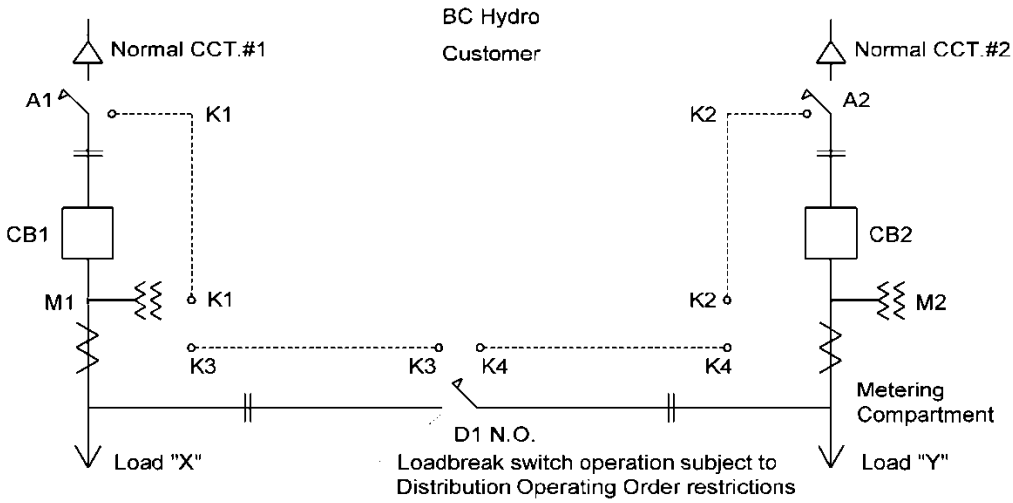
PG A1-01 One Line Diagram Single Radial Supply Typical for U/G Supply Service



PG A1-02 One Line Diagram Single Radial Supply Typical for O/H Supply Service



PG A2-01 One Line Diagram Dual Supply



Purpose of Key Interlock System

1. Allows momentary paralleling of either of the circuits during load transfer.
2. Prevents unsafe operation of disconnect switches and unsafe access to circuit breaker or metering compartment.

Key Interlock Sequence:

I. Access to BC Hydro metering compartment M1:
Open load-break switch A1 and release key K1. Retrieve K3 from D1 which is locked open. Insert K1 and K3 into M1 and open BC Hydro metering compartment M1. Follow the same procedure to access metering compartment M2.

II. To feed load "X" by normal circuit #1:
Open D1. Remove K1 from metering compartment M1. Insert K1 into A1 and close loadbreak switch A1 to feed load "X". Close circuit breaker CB1. Energizing the circuit follow the same procedure when feeding load "Y" by normal circuit #2.

III. To transfer load "X" from normal circuit #1 to circuit #2:
Close load-break D1 (K3 held captive). Momentarily parallel normal circuit #1 with circuit #2. Open load-break A1 and release key K1. Load "X" is now transferred to CCT #2. Similar procedure applies when transferring load "Y" from normal circuit #2 to circuit #1.

Note:

1. Key interlock is required between the circuit breaker and switch.
2. Distribution Operating Order (DOO) is required for Dual Supply installations.
3. For drawing legend refer to PG Z1-01.

Original signed by		DUAL SUPPLY SERVICE FOUR KEY INTERLOCK	
BChydro DISTRIBUTION STANDARDS		PG A2-02	1

PG A2-02 Dual Supply Service Four Key Interlock

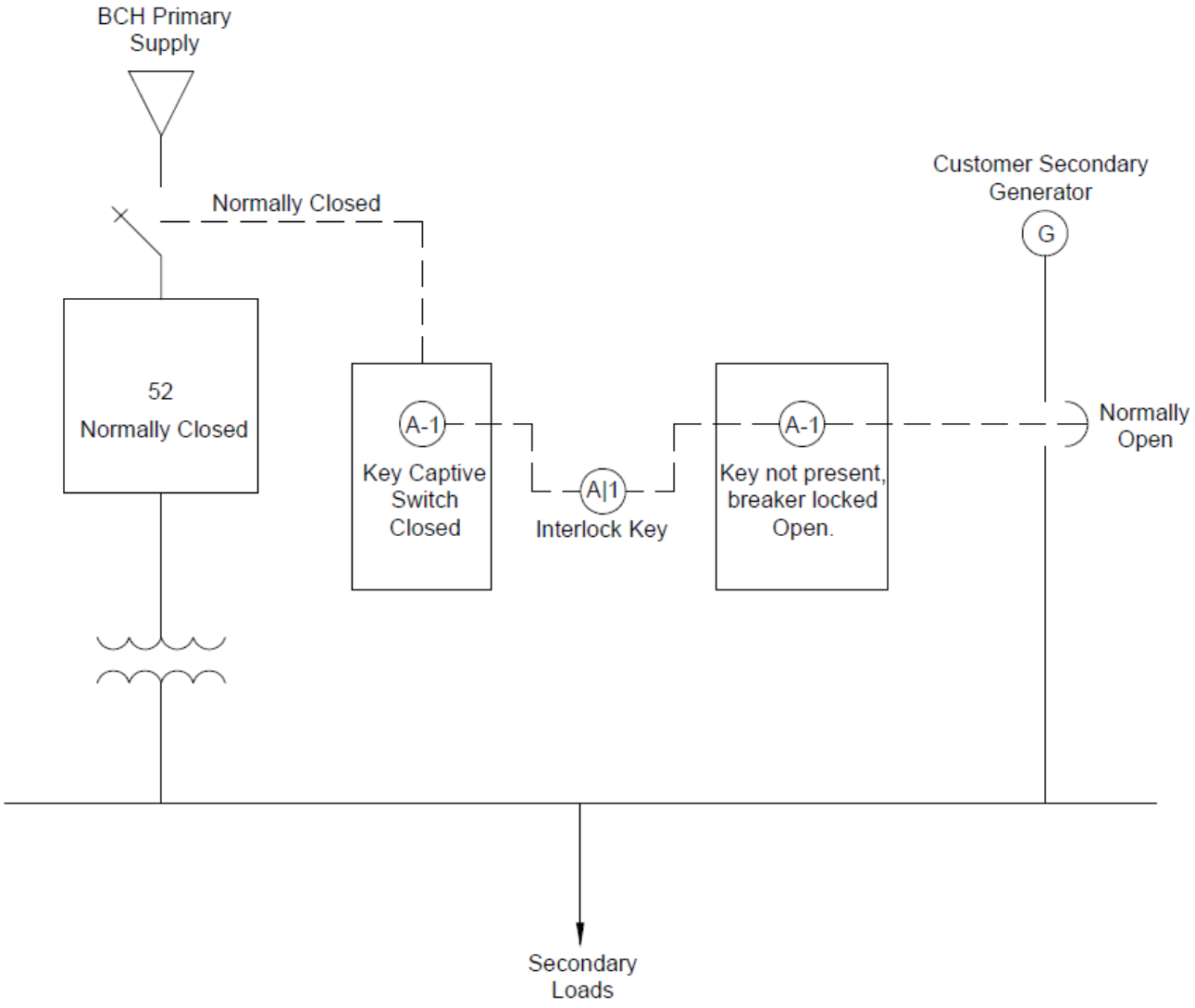


Figure A1-1 – Typical interlock scheme for locking out BC Hydro primary and customer secondary supply

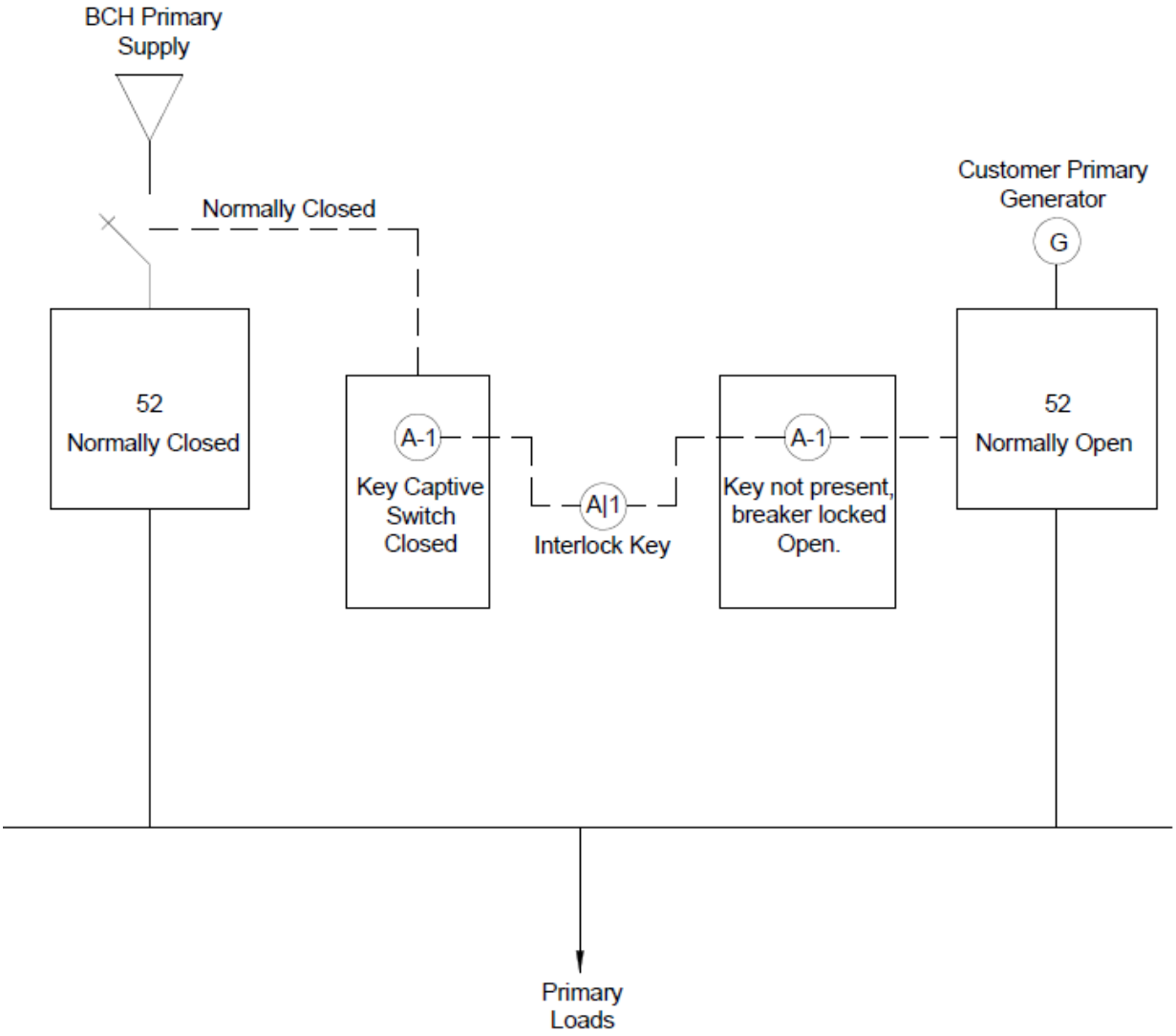
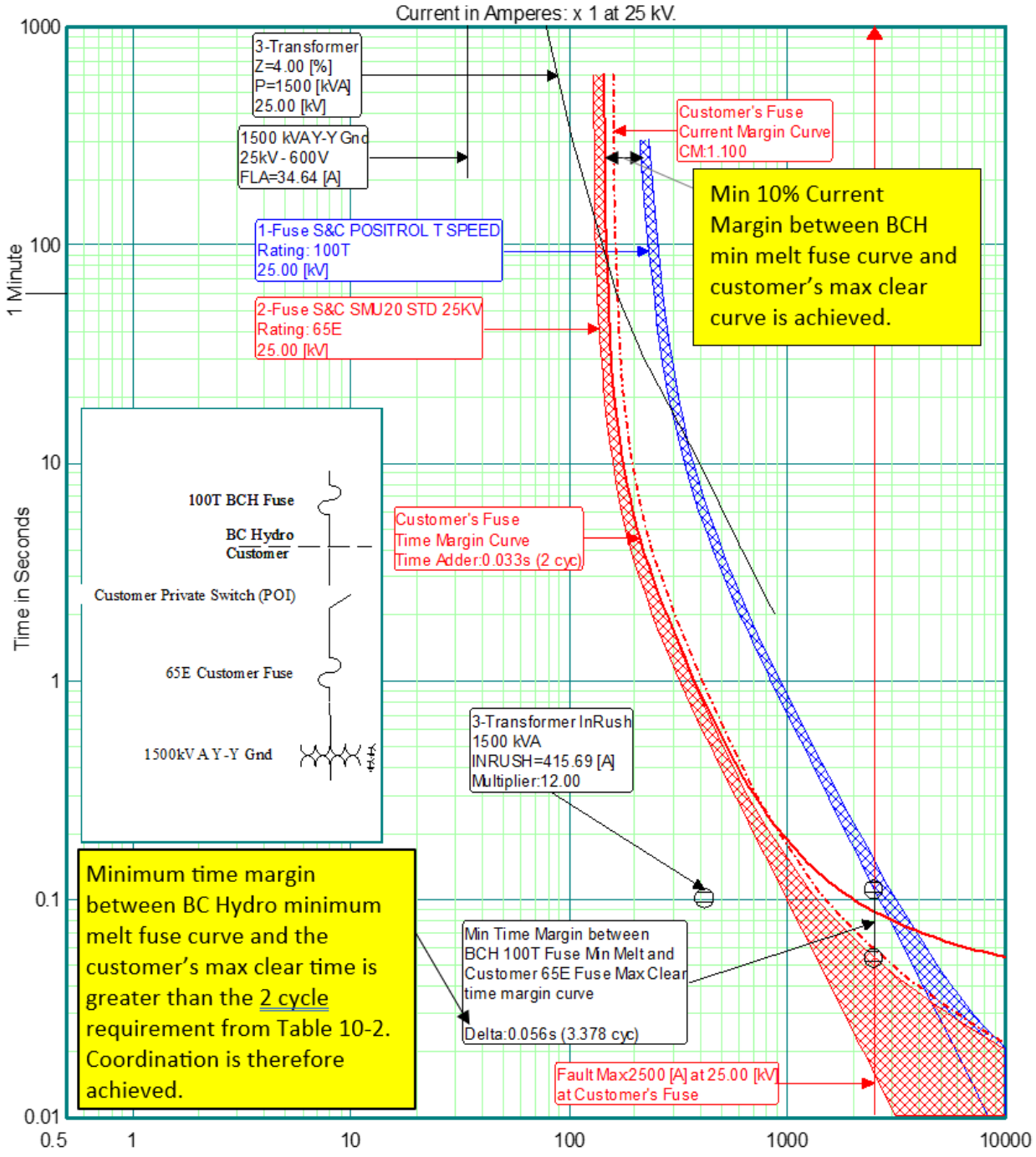
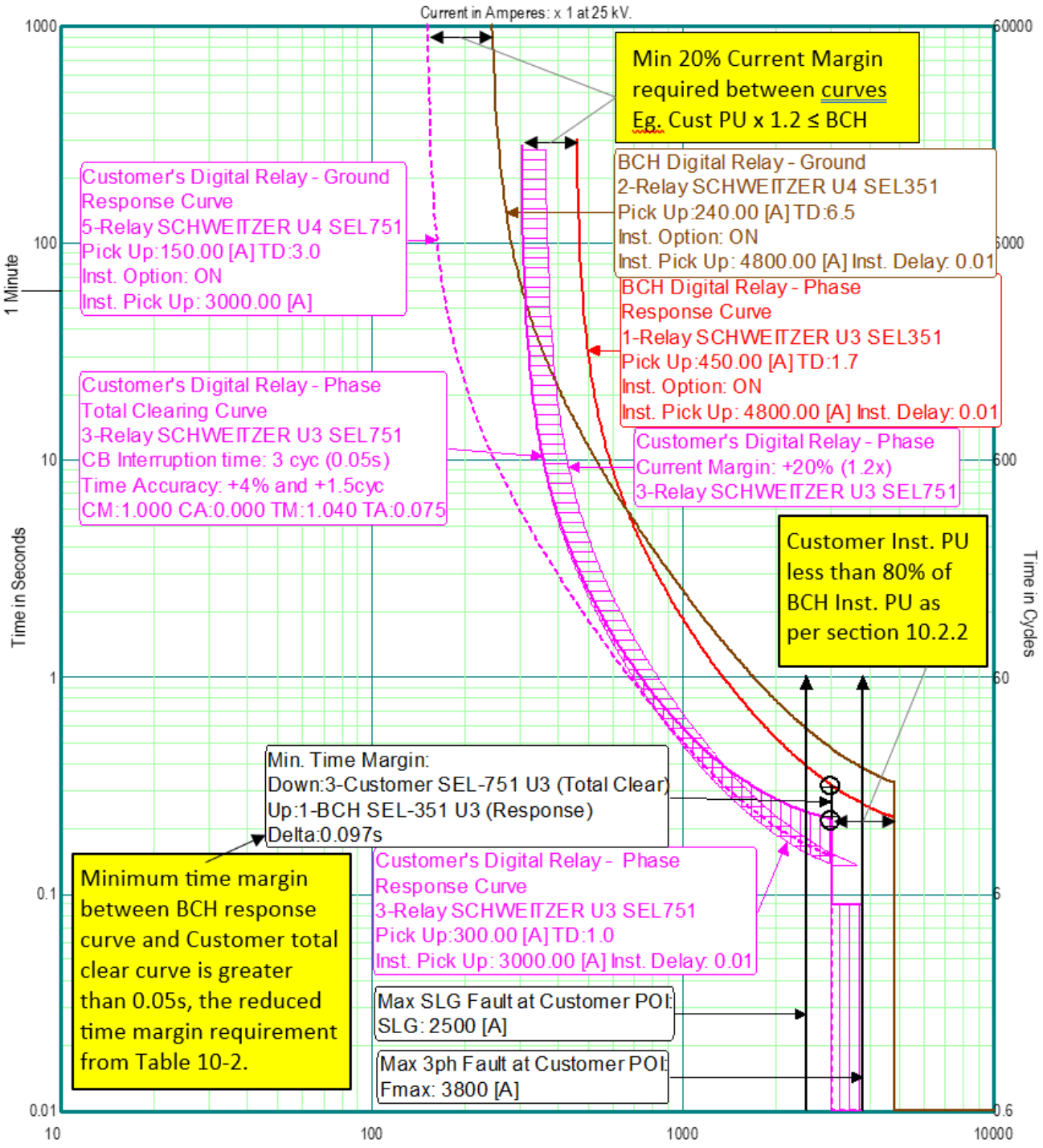


Figure A1-2 – Typical interlock scheme for locking out BC Hydro and customer primary supply

D Protection Coordination

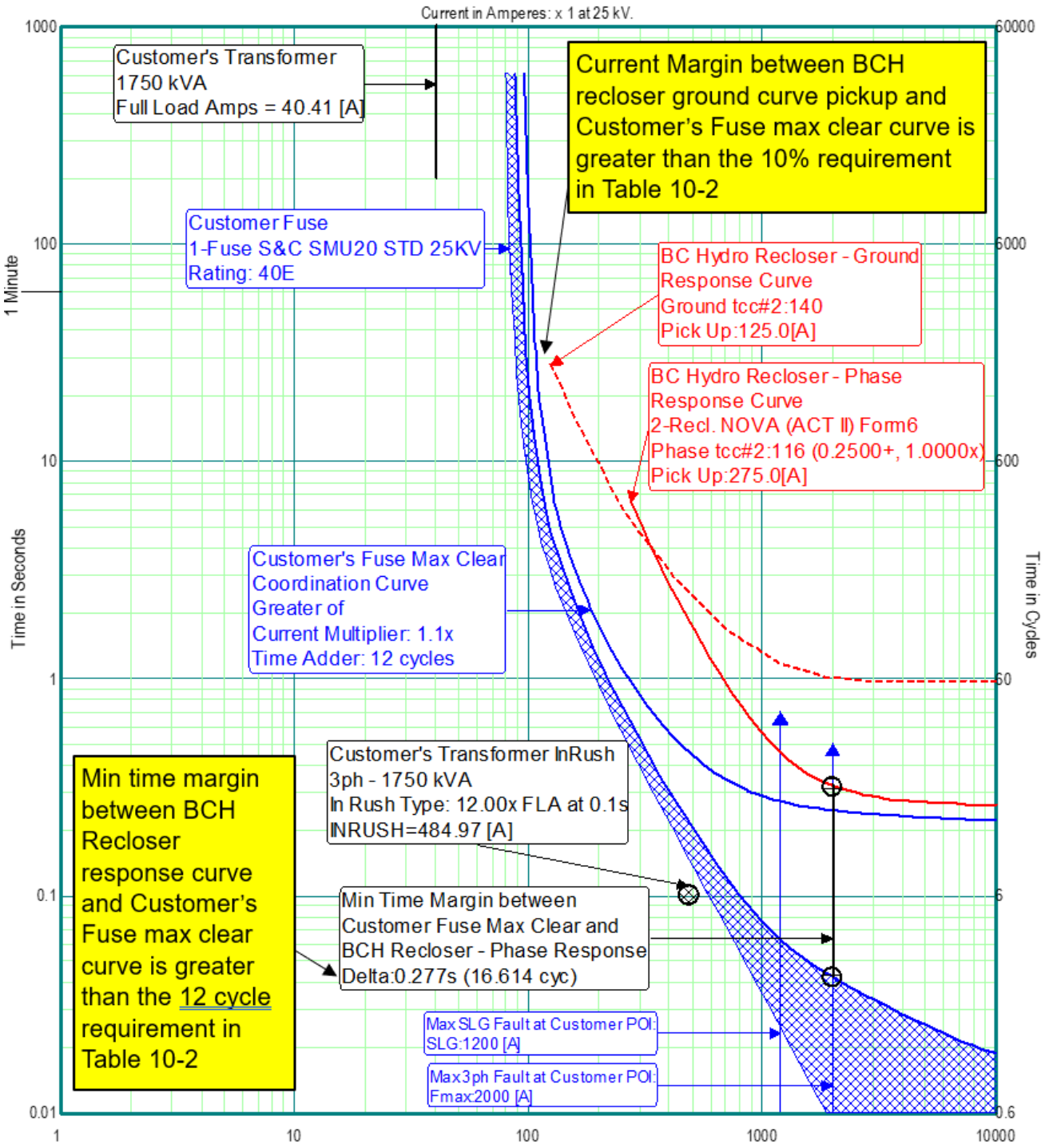


PG D1-01 Sample Protection Curves: Customer and BC Hydro Fuses

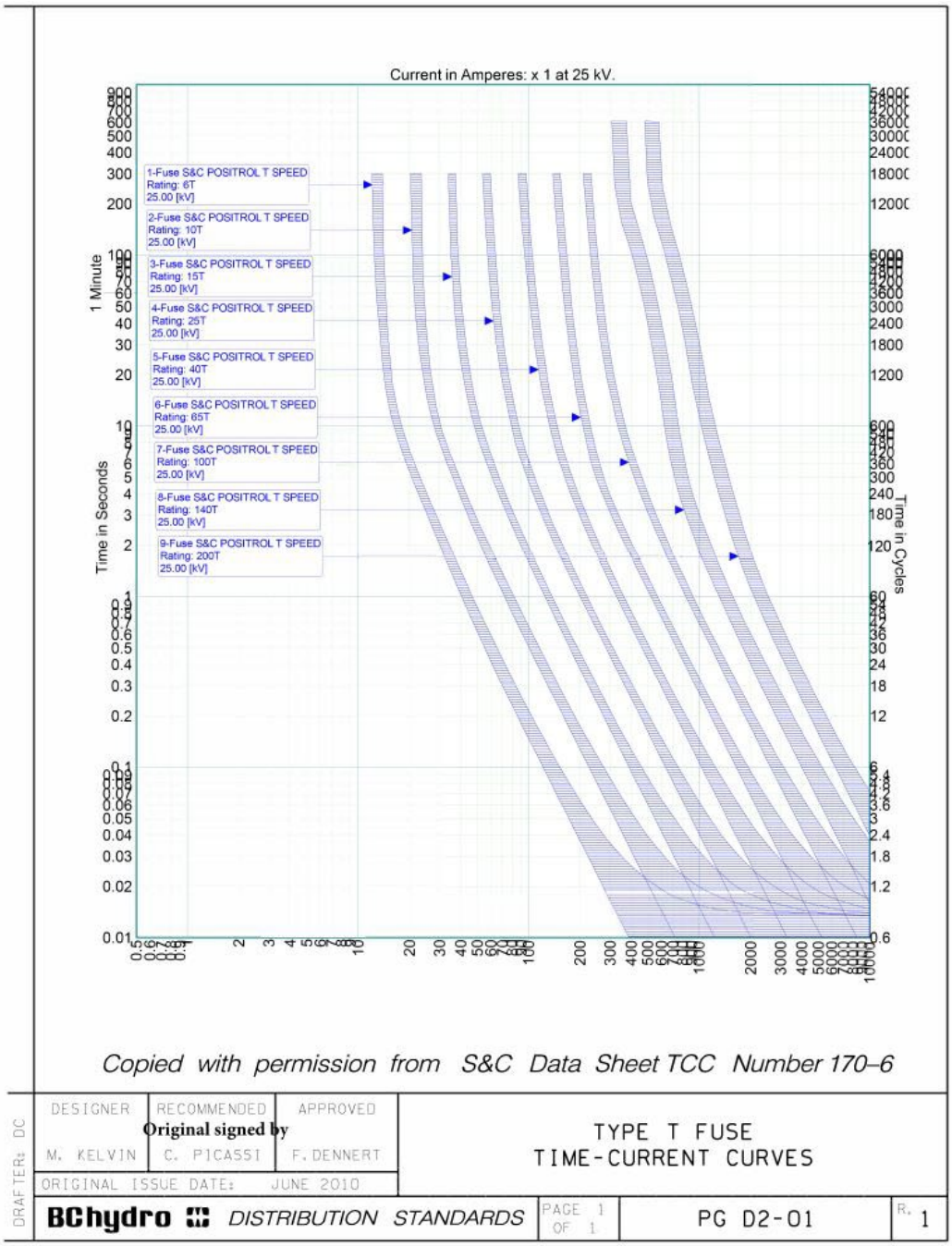


PG D1-02 Sample Protection Curves: Reduced Margin Between Customer Relay and BC Hydro Relay

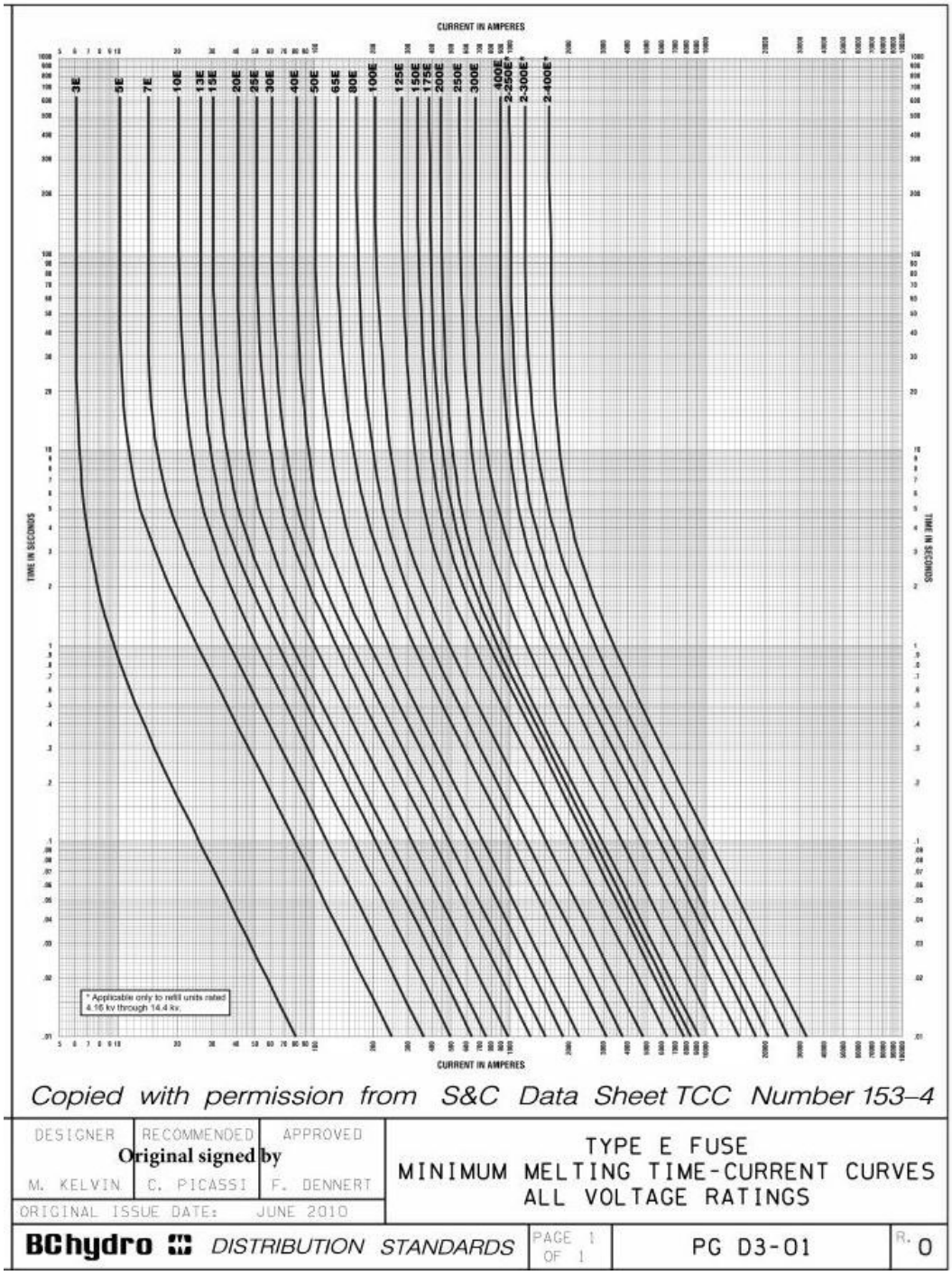
Customer transformer magnetizing inrush curve/point and BC Hydro negative sequence curve left out of this sample plot for clarity. See section 5.2.3 Protective Device Coordination Graph for time-current characteristic plot requirements.



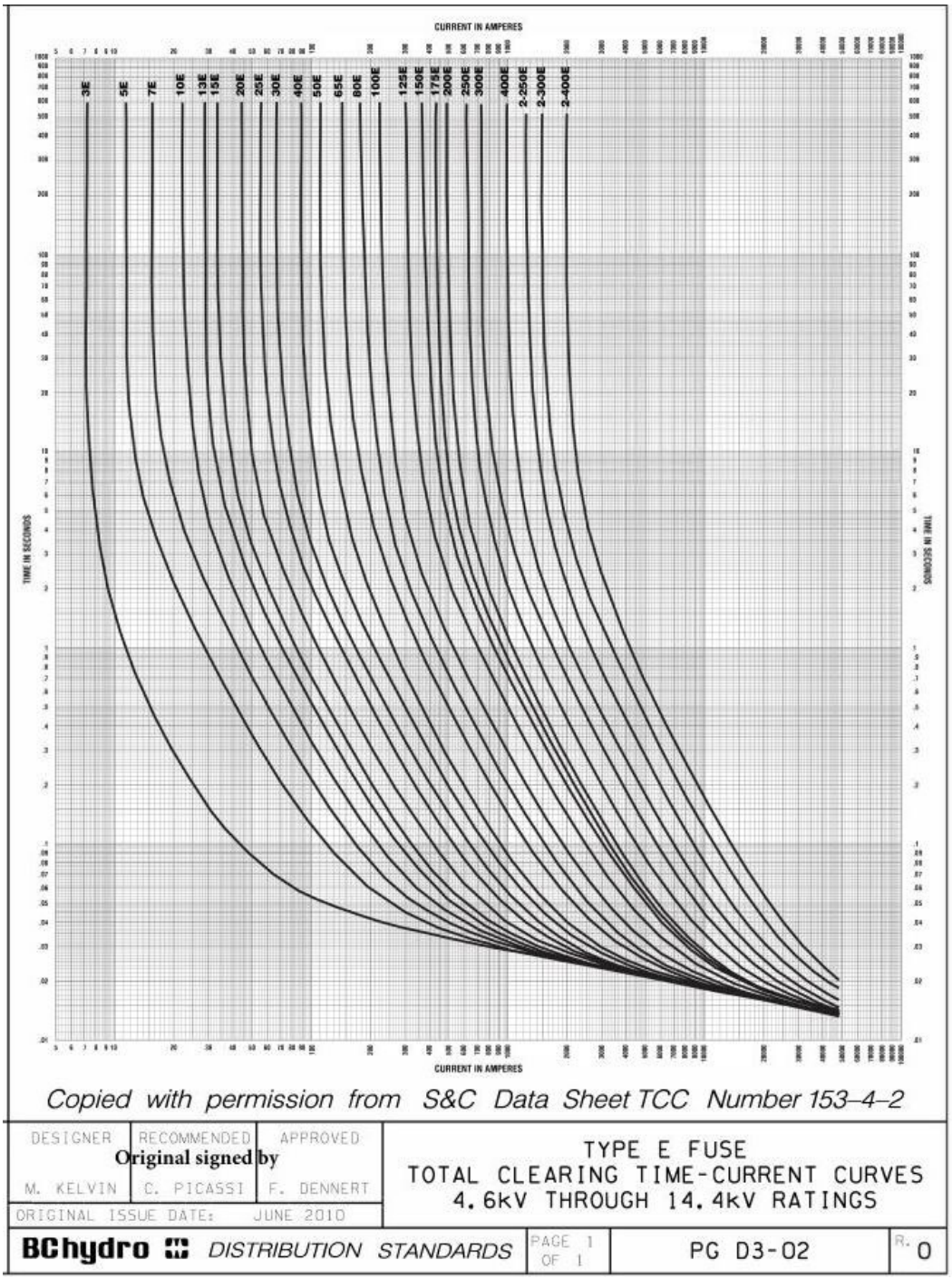
PG D1-03 Sample Protection Curves: Customer Fuse and BC Hydro Recloser



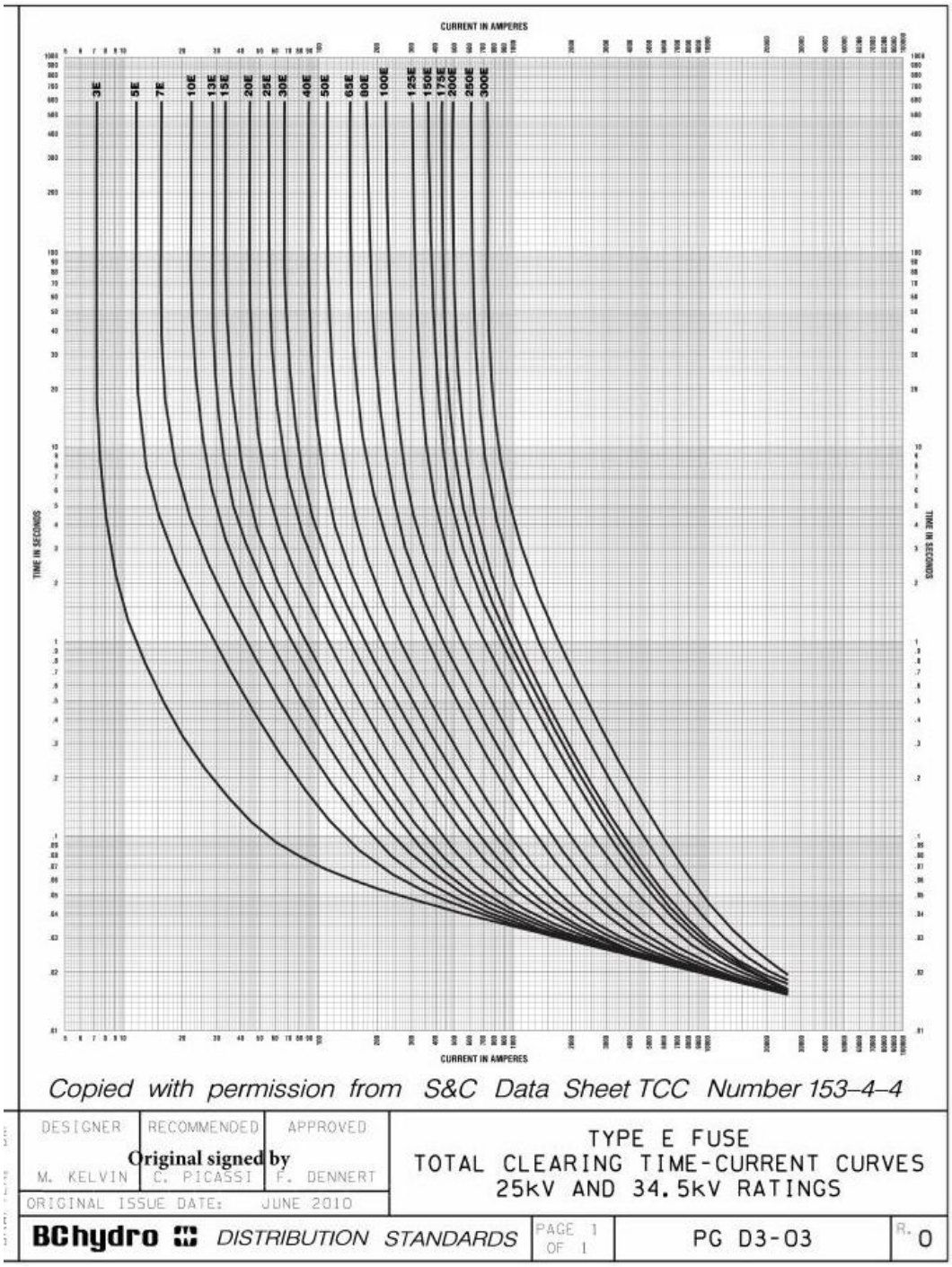
PG D2-01 Type T Fuse Time-Current Curves



PG D3-01 Type E Fuse Minimum Melting Time-Current Curves All Voltage Ratings

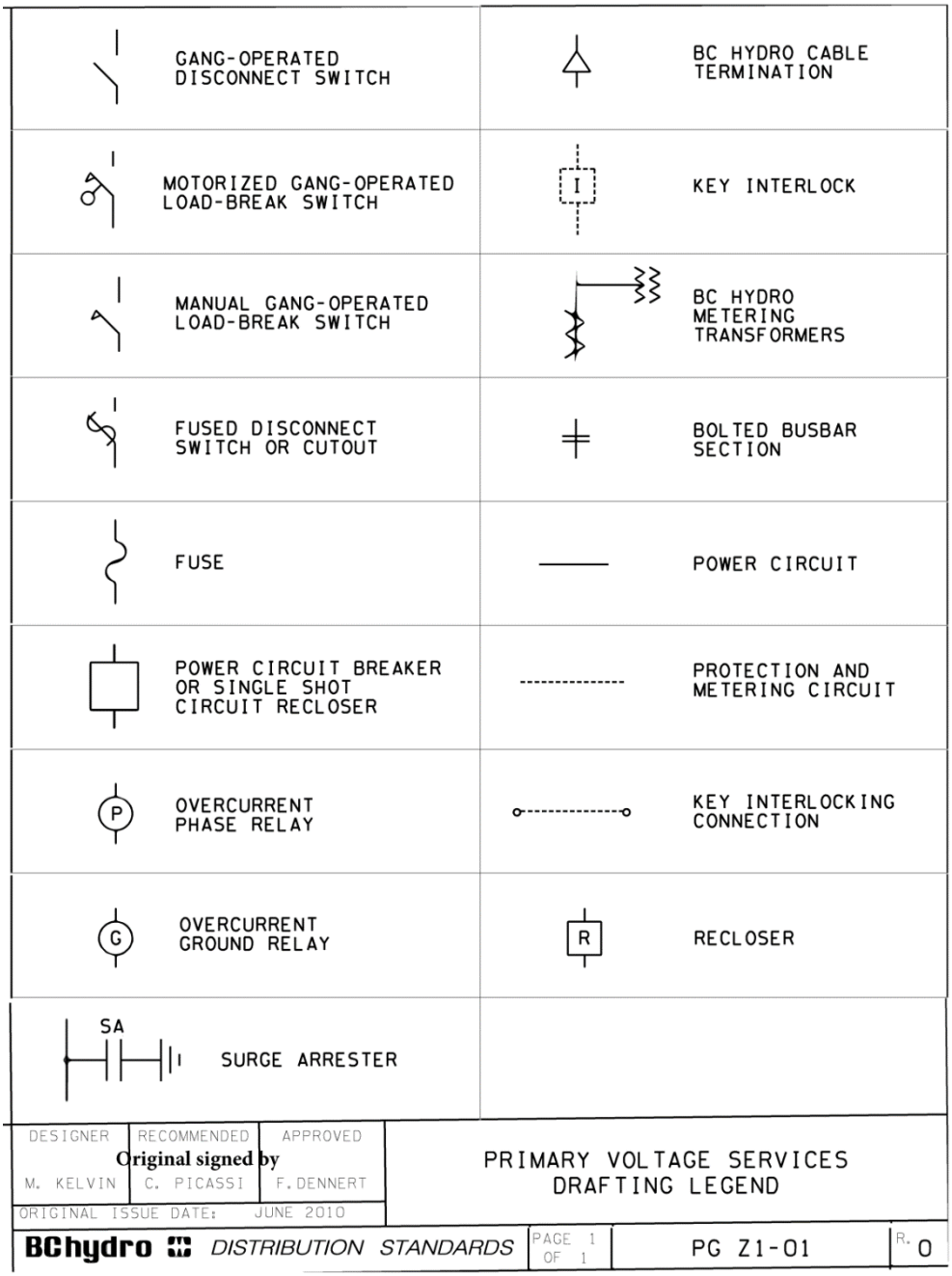


PG D3-02 Type E Fuse Total Clearing Time-Current Curves 4.6 kV and 14.4 kV Ratings



PG D3-03 Type E Fuse Total Clearing Time-Current Curves 25 kV and 34.5 kV Ratings

Z Engineering Data



PG Z1-01 Primary Voltage Services Drafting Legend

Appendix 2 Reference Documents

Persons using this manual are responsible for ensuring the following reference documents are the most recent versions.

Appendix Contents

BC Hydro *Primary Service Connections* Flowchart

BC Hydro Decal 9700-3719 *Notice No Storage Allowed*

BC Hydro Decal *Vault Identification Number*

BC Hydro Decal 9700-3120 *Building Electrical Service*

BC Hydro Decal 9700-4268 *Danger Keep Out*

BC Hydro Primary Service Cable Marker Plate

Primary Service Connections

- O Need a primary distribution voltage service connection (4kv to 35 kv)
- O Need a line on private property—not for utility takeover
- O Need to reconnect a primary service
- O Need to upgrade or alter an existing private line?
- O Require a larger service than typically supplied by BC Hydro?

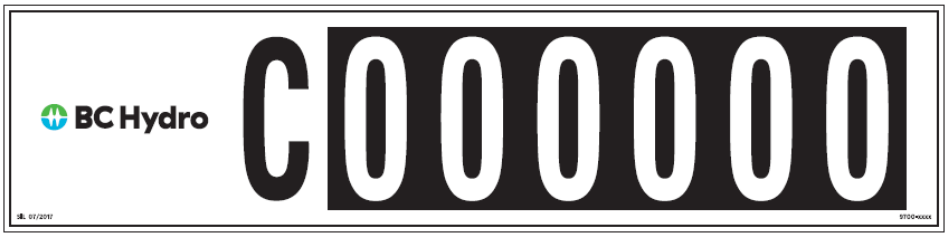
Start here if you know and have the information needed

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	Step 11
Advise BC Hydro of Primary Service Request	**Provide Preliminary Information**	**Customer's Electrical Design**	**Formal Application**	**BC Hydro Acceptance for Construction**	**Customer's Construction**	**Acceptance for Fabrication (if applicable)**	**Pay for Offsite Works, Onsite Materials**	**Inspections**	**Commissioning**	**BC Hydro Authorization for Connection**
Contact BC Hydro (Electrical Connection Centre) (phone or web)	**Provide** the information outlined in 5.1.1 of the Primary Guide	**Engage** an EGBC Professional Engineer to start work on the Electrical Design and Formal Application for Primary Service	**Make** a Formal Application with P. Eng. stamped design and all deliverables As per Tech Feas Review Reqts and 5.2 &5.3 of the Primary Services Guide **Pay** design deposit	**Receive** formal acceptance (or partial acceptance pending kiosk/ unit–sub Switchboard fabrication drawing submittal and acceptance—5.3)	**Obtain** electrical permit from AHJ and start electrical construction when authorized	**Submit** fabrication drawings of Primary Service Kiosk or Switchboard, Unit Sub (if these were not already submitted as part of Step 4) As per 5.3 of the Primary Guide	**Pay** quoted amount, pick up any BC Hydro provided materials for Customer's onsite electrical construction	**Arrange** BC Hydro Rep to inspect work at required stages (eg. mandrel of conduit) and all other inspection authority requirements	**Submit** all final deliverables– Primary Service Commissioning Report eg. authenticated record drawings by the POR(s) drawings, electrical permit etc. (as per 5.4 of Primary Guide)	**Service energized**
							Step 8 **Switchboard, Sub, Kiosk Fabrication** Order fabrication			
BC Hydro will: **Provide** you with letter outlining initial information you need to provide and refer you to the Primary Guide	**BC Hydro will:** **Work** with you to understand your project scope Undertake a Technical Feasibility Review **Provide** you with details of the servicing requirements to be met & deliverables to be submitted back to BC Hydro (5.1.2) **Request** a Design Deposit	**BC Hydro will:** **Work** with you and/or your engineer or utility representative on aspects of your design to meet requirements. **We will respond within 4 weeks,** either confirming acceptance or providing details of deliverables to be adjusted to reach acceptance	**BC Hydro will:** **Design and provide** a quote for any "offsite" work to connect to your point of service (this could include some civil required on your site) and also the estimate for the onsite materials that are to be provided by BC Hydro	**BC Hydro will:** **We will respond within 4 weeks,** either confirming acceptance or providing details of deliverables to be adjusted to reach acceptance				**BC Hydro will:** **Arrange** for BC Hydro Rep attendance/ inspection (eg. Civil Inspector)	**BC Hydro will:** **Undertake** final inspection **We will respond within 4 weeks,** either confirming acceptance or providing details of deliverables to be adjusted to energize **Build/finalize** any ancillary BC Hydro works **Energize** your service and **Start billing**	

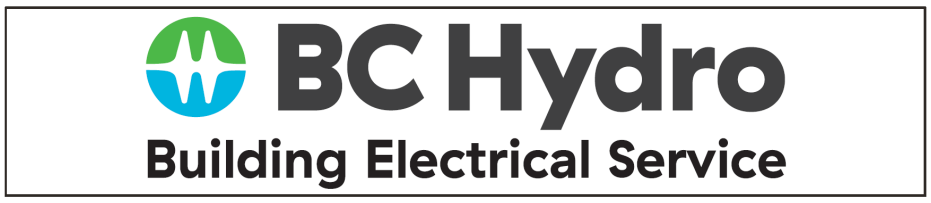
CX–5476

BC Hydro
Power smart

BC Hydro Decal 9700-3719 *Notice No Storage Allowed* (not to scale)

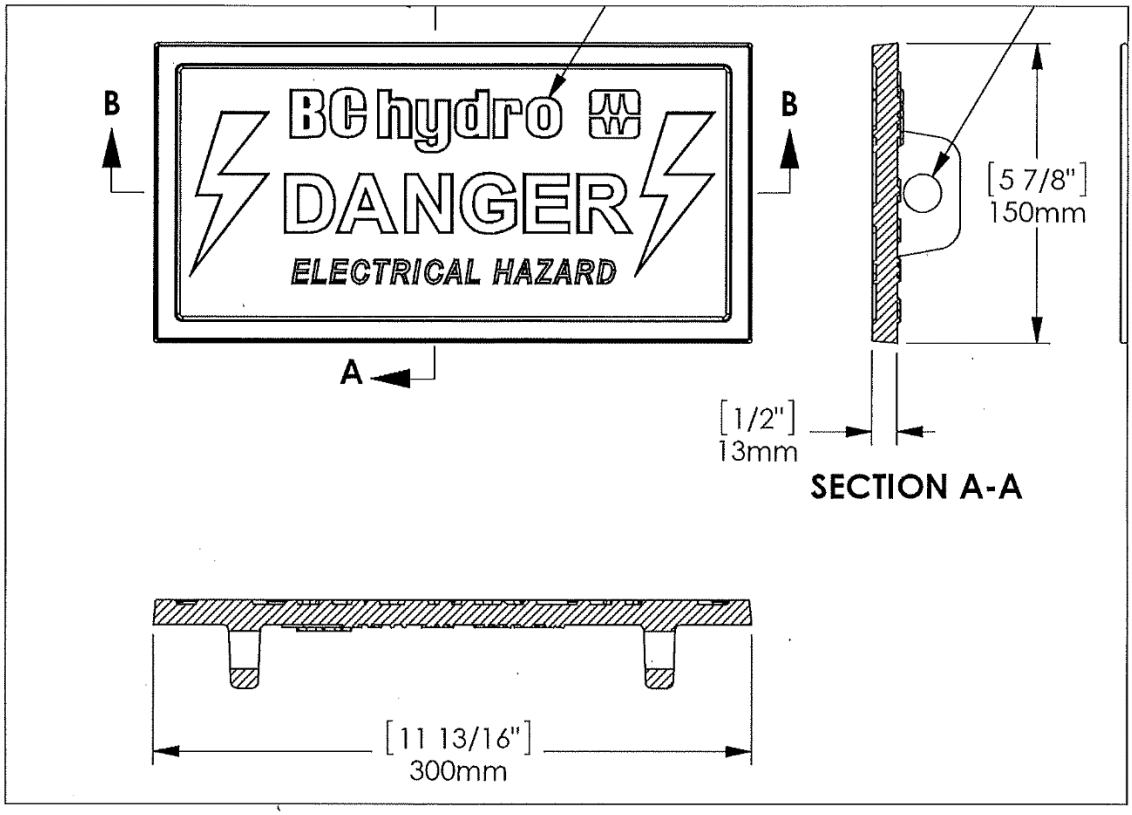


BC Hydro Decal *Vault Identification Number* (not to scale)



BC Hydro Decal 9700-3120 *Building Electrical Service* (not to scale)

BC Hydro Decal 9700-4268 *Danger Keep Out* (not to scale)



BC Hydro Primary Service Cable Marker Plate

Appendix 3 Photographs

Photographs in this appendix may depict installations which do not meet the requirements of this document. Some of these installations were part of a multi-year homologation process, including multiple beta sites for each different equipment design. The non-compliances shown were found to be non-functional in nature and were typically accepted to support advancing BC Hydro's homologation process. Supply authority requirements for this new technology have changed and improved with time. This appendix shall be considered informative and shall not determine compliance with this document.

Appendix Contents

Figure A3-1 – BC Hydro utility service cable compartment (live-front)

Figure A3-2 – Utility service cable compartment showing disconnect switch and primary bus work (live-front)

Figure A3-3 – BC Hydro cable termination with ground stud boot removed (live-front)

Figure A3-4 – Customer-owned primary service fuse compartment

Figure A3-5 – Primary revenue metering compartment

Figure A3-6 – Customer fuse compartment with customer primary service cable terminations

Figure A3-7 – Customer service switch and O/C protection on first pole and BC Hydro primary revenue metering on second pole

Figure A3-8 – Customer-owned dead-front kiosk with both doors closed

Figure A3-9 – Dead-front kiosk both doors open showing grounding switch above and service cable bushings below

Figure A3-10 – Service cable clamps and adjustable cable support channel

Figure A3-11 – Close-up of dead front BC Hydro utility service cable compartment with terminators, cable supports, and grounding

Figure A3-12 – Dead front primary service kiosk by Power Systems Technology showing service main

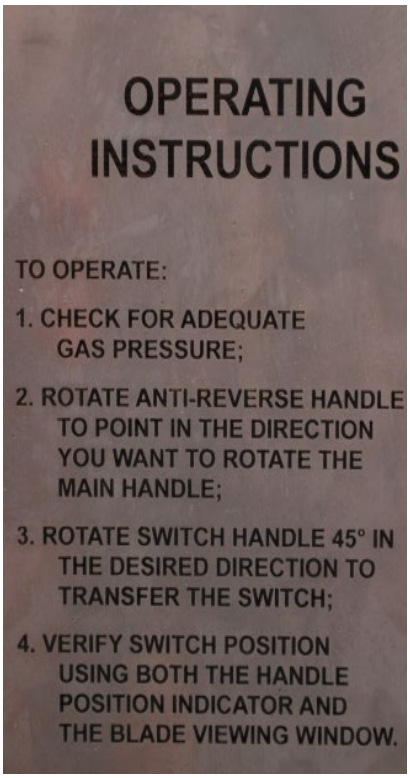


Figure A3-13 – Operating instructions

Figure A3-14 – BC Hydro utility cable compartment and cable supports and grounding

Figure A3-15 – BC Hydro grounding position lock

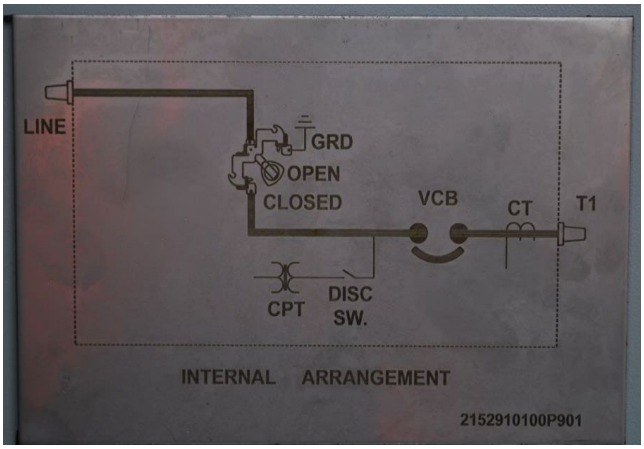


Figure A3.16 – Mnemonic single line diagram

Figure A3-17 – Dead-front primary service kiosk by S&C Electric showing BC Hydro as way 1 and customer service main as way 2

Figure A3-18 – Dead-front primary service kiosk by S&C Electric with BC Hydro as way 1 and customer service main as way 2, covers open

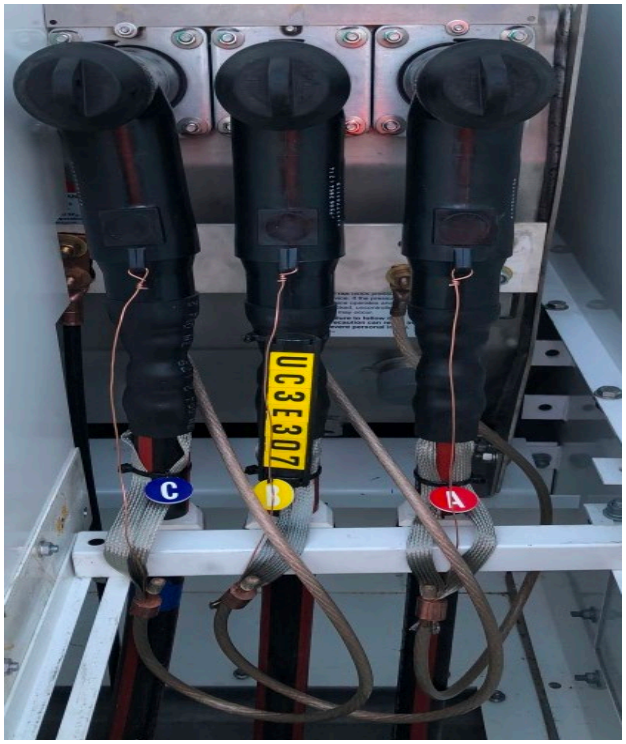


Figure A3-19 – BC Hydro utility cable compartment and cable supports and grounding

Figure A3-20 – BC Hydro grounding position lock

Figure A3-21 – Mnemonic single line diagram and customer locks